Historic, archived document

Do not assume content reflects current scientific knowledge, policies, or practices.

6Frr

FOREST RESOURCES *of the* Lake States Region

LIBRARY
CURRENT SERIAL RECORD
JAN 3 1951
U. S. DEPARTMENT OF AGRICULTURE

FOREST SERVICE

United States Department of Agriculture

Forest Resource Report No. 1

ACKNOWLEDGMENT

Much credit is given to the many workers who participated in the initial forest survey (1934–36) and subsequent reappraisals of resource data upon which this report is based. In the initial survey J. W. Girard, from the Washington Office, U. S. Forest Service, was especially helpful in developing plans and procedures. Special mention is also made of the men responsible for the various phases of the survey: H. C. Moser who served as assistant to the author and was in charge of the compilation of data; E. L. Lawson, chief of field parties; S. R. Gevorkiantz, in charge of growth studies; and H. G. White, in charge of depletion studies.

In the recent reanalysis of survey data, major contributions to this appraisal of the forest situation were made by the following: Arthur Horn, in charge of compiling production estimates, assisted by Dorothy Keller, John Neetzel, Zigmond Zasada, and Waldo Sands; Paul Rudolf, Russell LeBarron, William Kluender, and Howard Mayne, who compiled the ownership data; Clarence Chase and S. R. Gevorkiantz, who were in charge of the computation of drain, growth, and revised inventory statistics.

Valuable cooperation in compiling up-to-date estimates was given by the following: Stanley Fontanna, George McIntire, and members of their staff, Michigan Department of Conservation; Fred Wilson, Wisconsin Department of Conservation; H. G. Weber, James Gannaway, and E. L. Lawson, Minnesota Department of Conservation; Joseph Donery, American Forestry Association; H. Basil Wales and the Supervisors of the Lake States National Forests; William Heritage, U. S. Office of Indian Affairs; and U. J. Noblet, Michigan School of Mines.

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST RESOURCE REPORT NO. 1
WASHINGTON, D. C., 1950

234922

Forest Resources of the Lake States Region

* * *

R. N. CUNNINGHAM, *forest economist*
and FOREST SURVEY STAFF
LAKE STATES FOREST EXPERIMENT STATION
(Maintained by the U. S. Department of Agriculture, Forest Service, at St. Paul, Minn., in cooperation with the University of Minnesota.)

UNITED STATES GOVERNMENT PRINTING OFFICE · WASHINGTON · 1950

FOR SALE BY THE SUPERINTENDENT OF DOCUMENTS, WASHINGTON, D. C., PRICE 30 CENTS

Preface

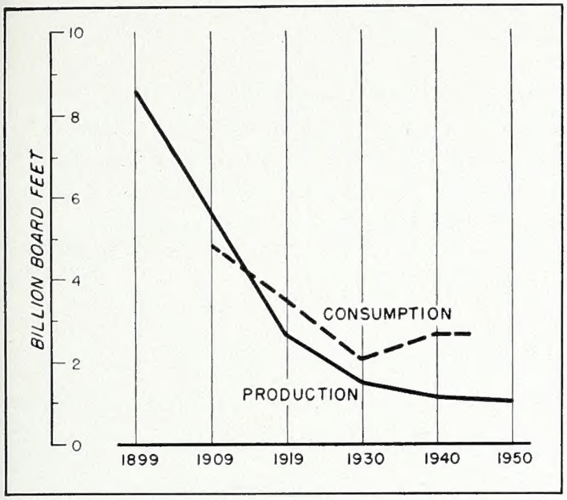
One of the important research undertakings of the United States Forest Service in recent years is a Nation-wide forest survey. The survey was authorized in the McSweeney-McNary Forest Research Act of May 22, 1928, and has now been extended to most of the important forest regions. This report deals with the results of the survey in the Lake States region—Minnesota, Wisconsin, and Michigan. It is based on a field inventory completed before the war (1934–36), a reappraisal of resource data made in 1945, and the results of resurveys made in certain counties since 1946.

Forests have played an important part in the development of the Lake States during the past 75 years, and even today they are a major element in the economy of the region. The survey of forest industries has disclosed thousands of primary wood-using plants engaged in converting logs and cordwood into lumber, pulp, shingles, etc., and many additional secondary operations engaged in further processing of the lumber and pulp. More than 100,000 men are employed to cut, transport, and manufacture forest products, and the finished products bring much revenue into the region.

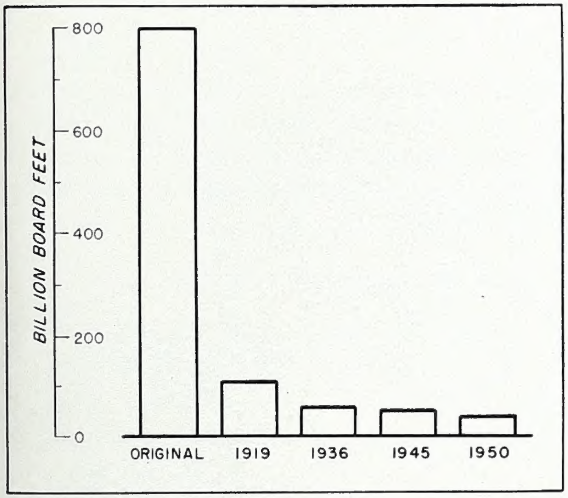
A number of sawmills and other wood-using plants in the Lake States have closed during the past decade, and some concern has been felt for the security of others because of a progressive decline in quantity, quality, and availability of standing timber. A major purpose of the survey, therefore, was to determine the extent of remaining timber supplies, the wood requirements of local industries, and the possibilities of meeting these requirements through proper management of the forest resources. Consideration was also given to the possibility of developing new industries to utilize materials hitherto left in the woods or wasted in the logging and milling process.

While this report deals primarily with physical resources, the underlying purpose has been to measure the capacity of the forests to contribute to local revenue, employment, and community welfare.

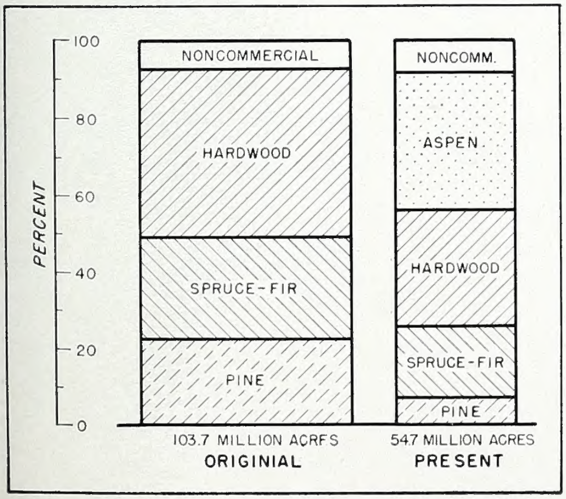
SURVEY HIGH LIGHTS



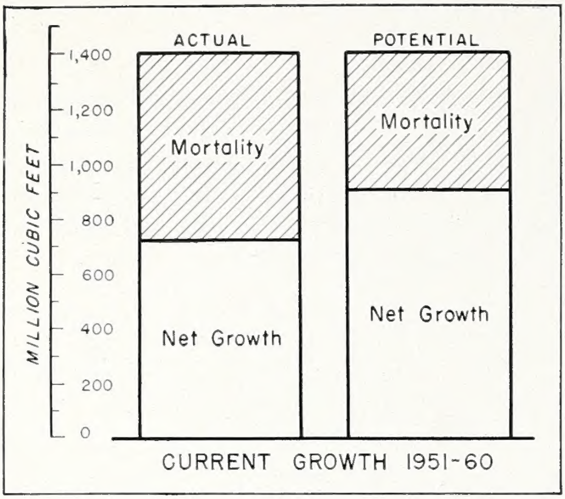
Forests are not filling local lumber requirements in the Lake States. Current production of sawmills—one-eighth of that in 1889—supplies only one-half the lumber now used in the region. Similar shortages appear in coniferous pulpwood, high-grade veneer logs, and many other items.



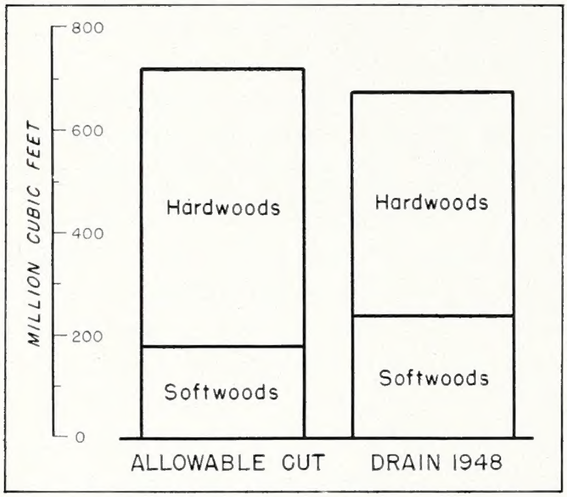
Poor production stems from depleted growing stock. Part of the decline in recent years reflects changes in specifications. Only about 5 percent of the original saw-timber stand remains.



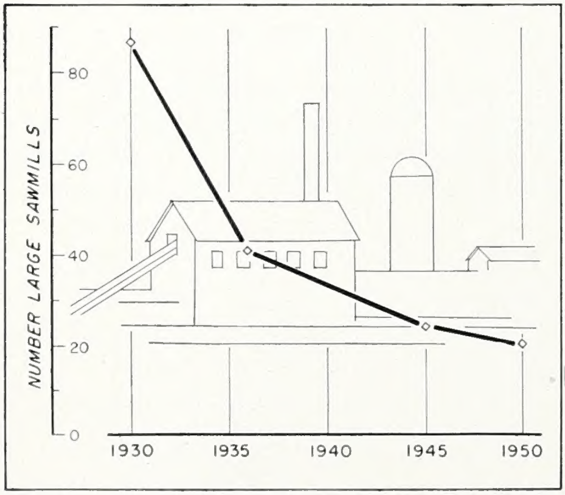
Reduced forest area, deteriorated types, and poor distribution of stand classes are among the reasons for low current yields—too much aspen, not enough of softwood types.



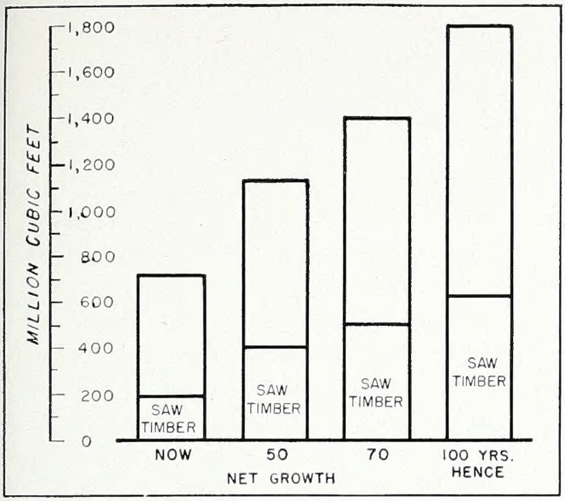
Current annual net growth is lower than in most other forest regions of the United States. Mortality from suppression, wind, fires, insects, and diseases almost equals net growth. Mortality could be reduced by improved forest management.



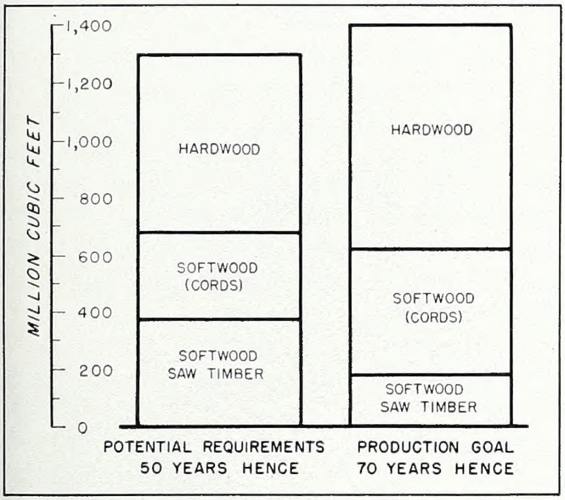
Annual drain (1948) on standing timber was not too great. However, it consisted too largely of softwoods, was concentrated too much in accessible areas, sometimes was accomplished by destructive logging practices.



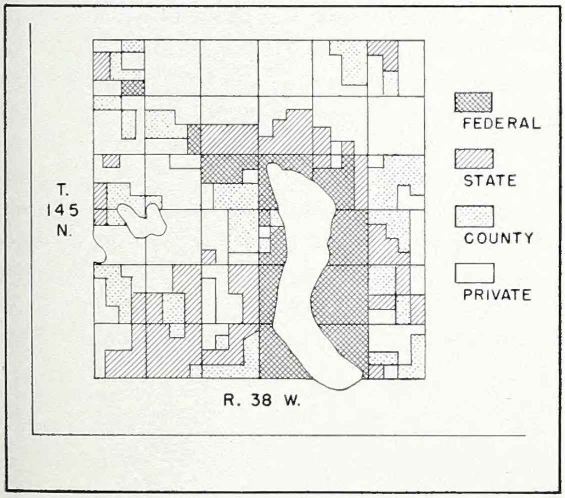
Liquidation of accessible timber has closed many large sawmills in recent years — threatens many others.



The long-run forestry possibilities of the region are good. With good management, in 70 years stands can grow at least twice as much cubic volume of wood, 2½ times as much saw-timber volume as at present.



Realizable production goal can fill major requirements. In 70 years the forests can yield most of the timber products prospectively required—will fall short mainly in softwood saw timber.



Mixed ownership complicates management. Public and private lands are widely intermingled and plans for managing have not been well coordinated.

Contents

PAGE

- Background of forest situation 1
  - Physical conditions 1
    - Drainage 1
    - Climate 1
    - Soil and topography 1
  - Economic and industrial conditions 3
    - Area and population 3
    - Agriculture 4
    - Industry 4
  - Major forestry problems 5
- Forest inventory 6
  - Areas 6
    - Commercial forest 6
      - Stand classes 6
      - Present forest types 7
      - Potential forest types 13
    - Noncommercial forest 15
    - Forest-land ownership 15
      - National forests 17
      - Indian forests 17
      - Other Federal lands 18
      - State forest lands 19
      - County and municipal forests 19
      - Farm woods 20
      - Other privately owned forest lands 20
  - Volumes 21
    - Primary growing stock 22
      - Saw timber 22
      - Cordwood volume 23
      - Total cubic-foot volume 23
      - Ownership 23
    - Secondary material 25
- Growth and mortality 27
  - Current annual net growth 27
  - Mortality 27
    - Suppression and deterioration 27
    - Forest fires 28
    - Insects and diseases 28
    - Other losses 28
  - Potential current growth 29

PAGE

Growth and mortality—Continued

  - Potential future growth and yields 29
- Forest industries 31
  - Sawmills 31
  - Pulp and paper mills 32
  - Other wood-processing mills 34
    - Hardwood veneer mills 34
    - Excelsior mills 34
    - Wood distillation plants 36
    - Slack cooperage mills 36
    - Lath mills 36
    - Shingle mills 36
  - Producers of rough forest products 36
    - Fuel wood 36
    - Fence posts 37
    - Poles and piling 37
    - Mine timbers 37
    - Miscellaneous rough products 37
- Timber drain 38
  - Trends in drain 40
  - Allowable cut 41
  - Allowable cut in relation to growth 41
  - Drain in relation to growth and allowable cut 42
- Future production goal 45
  - Current consumption 45
  - Potential future requirements 45
  - Capability of the land 46
    - Yields from natural stands 46
    - Additional yield from plantations 47
  - Logical forestry objectives 47
- How goal can be reached 48
  - Major facts shown by survey 48
  - Specific measures needed to gain objectives 49
- Literature cited 53
- Appendix 55
  - How the survey was made 55
  - Common and botanical names of principal tree species 55
  - Supplemental tables 56

Background of Forest Situation

THE Lake States region—Minnesota, Wisconsin, and Michigan—after a century and a half of settlement, land clearing, lumbering, and forest fires, is essentially a cut-over region. It contributed first its large pine, then its hardwoods, more recently its pulp timber to the upbuilding of the Middle West. The nontimbered character of much of the surrounding territory—the Great Plains to the west, and intensively farmed and industrial areas to the south—created demands for Lake States timber and was a factor in causing early liquidation of the original pine forests. Likewise it is a feature deserving some attention in connection with future timber growth goals.

Today the region faces the problem of supplying as much as possible of its own timber needs without paying excessive cross-country freight, of supporting a very valuable pulp and paper industry and other wood-using plants, of giving employment to settlers in the poorer agricultural districts, and of stimulating an active tourist and recreation industry, all on a foundation of young second-growth timber.

This problem, which has been partially recognized for a number of years, has been brought into sharp focus by the special demands for timber that developed during and since World War II. It has led to a desire on the part of the Lake States public to do something constructive, to rebuild the forests, and insure an adequate timber supply for the future. They want to take stock of the situation and then act.

The situation in its broader aspects is very well known *(18, 20, 21, 22, 45, 46)*,[1] but a brief review may lead to a clearer understanding of the facts shown by the Forest Survey.

Physical Conditions

Drainage

The region contains headwaters of three major drainage basins, one part draining north into Hudson Bay via the Red River, another draining south into the Gulf of Mexico via the Mississippi, and a third draining east to the Atlantic through the Great Lakes and St. Lawrence River. In general, watershed boundaries are inconspicuous and have relatively little effect either upon forest conditions or ordinary economic activity.

Climate

The drop in mean temperature from south to north and in annual rainfall from east to west accounts in part for the distribution of forest types. Likewise, it has a major influence upon agriculture in the region.

The average frost-free growing season is about 180 days at the southern end of Lake Michigan, whereas it is less than 100 days on high ground in the northern part of the region. Average January temperature in northern Wisconsin is 8° F. compared with 21° in the south. Average July temperature is 64° in the north, 73° in the south. Extremes range from 50° below to more than 105° above zero (*22*).

Mean annual precipitation ranges from 36 inches near the southern border of Michigan to about 20 inches in northwestern Minnesota. The northern part of the region ordinarily is covered with snow for 90 to 120 days.

The cool moist climate in the north favors the development of coniferous forests. It places limitations on certain types of agriculture. The warmer temperatures and more generous summer rainfall in the south have favored agricultural development at the expense of the forests wherever soil conditions permit.

Prairie conditions in the western part of the region reflect smaller summer rainfall.

Soil and Topography

The region as a whole is level without prominent peaks or valleys. The highest land is about 2,200 feet above sea level in northeastern Minnesota; the lowest about 600 feet adjacent to the Great Lakes.

---

[1] Italic numbers in parentheses refer to Literature Cited, p. 53.

Glaciers, which at one time covered virtually the entire region, left many moraines—heaps of boulders, gravel, sands, silt, and clay—with hundreds of small lakes scattered throughout. These are most noticeable across central Minnesota, Wisconsin, and the Lower Peninsula of Michigan (fig. 1). The smoother parts with heavier soils are farmed. The steeper and stonier parts, being of little use for farming, have remained in forests as have also many of the intermingled pot holes and poorly drained depressions. Some of the best red and white pine grew on these moraines.

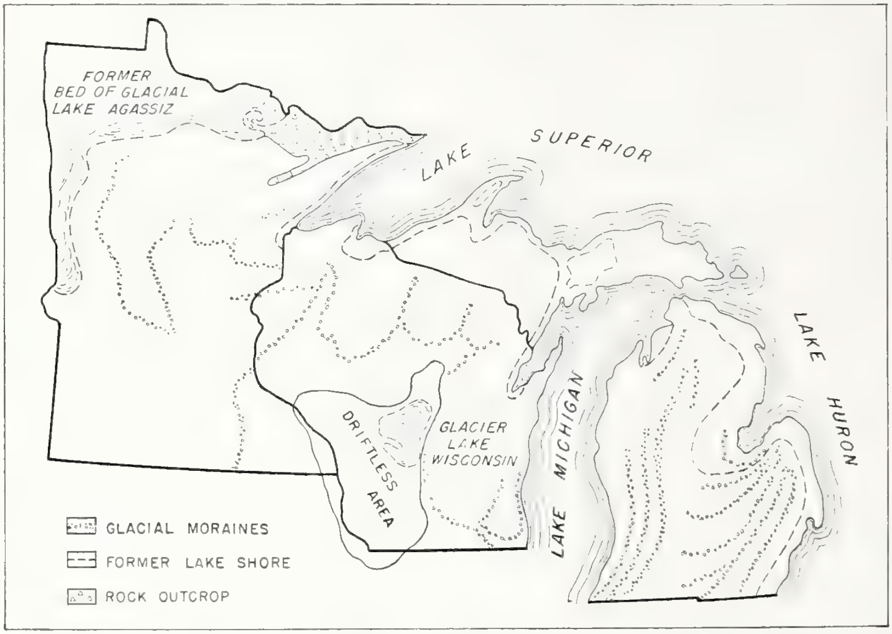


Figure 1.—*Significant topographic features of the Lake States region.*

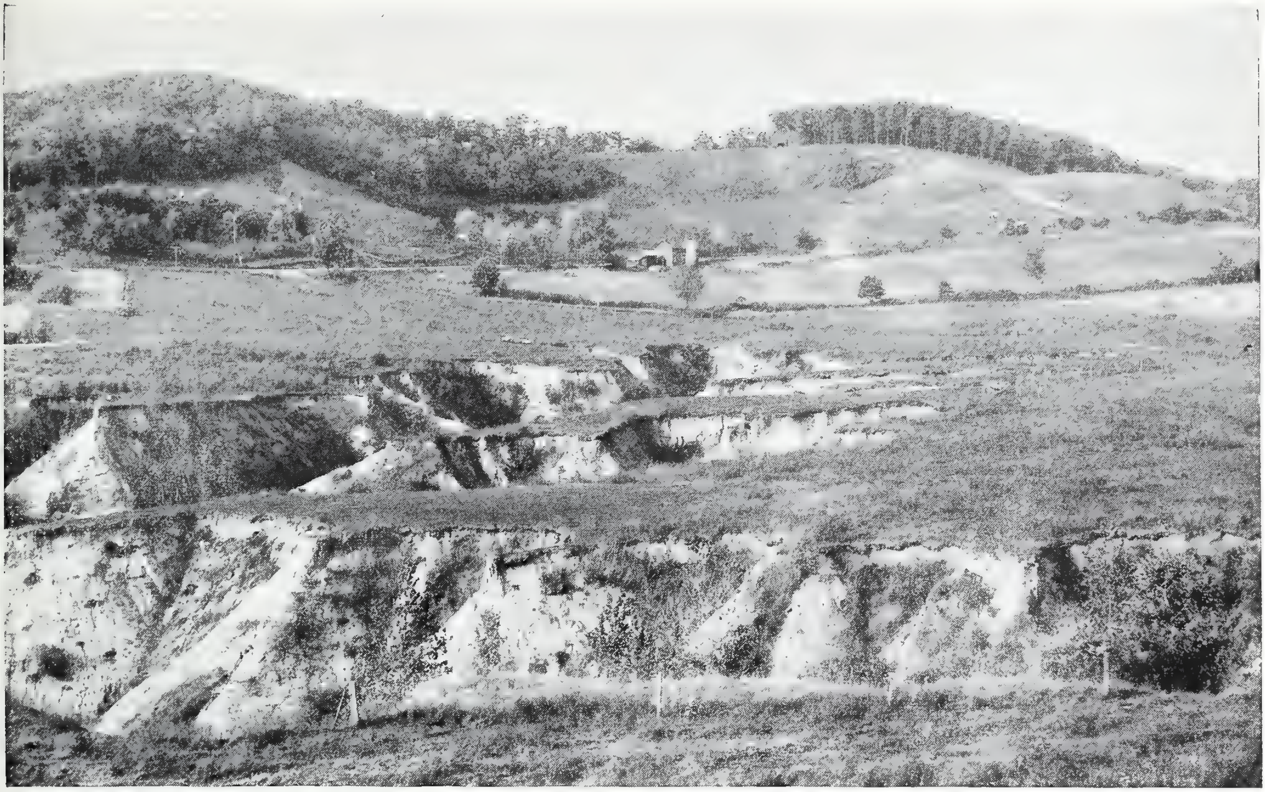
Glacial till plains generally are of better texture and less broken profile. Usually they are fertile and, in districts of favorable climate, make good farm land.

Glacial outwash plains are mostly coarse sand, not highly valued for agricultural development. In the north, they produce jack or red pine; in the south, scrub oak.

A narrow band of heavy clay soils adjoining the Great Lakes occupies area formerly covered with water. This is fertile soil and in the south it makes good farm land. In the far north, it tends to be cold, poorly drained, and intractable. Some of this land, as for example near Duluth, produced excellent white pine in the original forest; but its second growth is mainly aspen of intermediate quality with little evidence of any tendency to revert to pine.

Receding glaciers left several sizable lakes, including Lake Agassiz, which covered northwestern Minnesota and thousands of square miles in North Dakota and adjacent parts of Canada. Lake Winnipeg, Rainy Lake, and Red Lake are remnants. The former bed of Lake Agassiz and similar smaller lakes now contain extensive tracts of peat of varying depths, with scattered dunes or "islands" of sand. The characteristic vegetation is spruce, tamarack, and cedar trees, or some of the various rushes, sedges, and shrub species adapted to wet ground. Pine trees grow on many of the islands.

The bluff lands on both sides of the Mississippi River from St. Paul south to the regional boundary at Dubuque, Iowa, present a particularly severe erosion problem. This 10,000-square-mile area contributes millions of tons of silt to the Mississippi annually, and thousands of acres of good farm land have been gullied beyond repair. Erosion has resulted in part from cropping or pasturing steep land that never should have been cleared, and in part from using improper cropping methods on good agricultural land. In recent years progress has been



F—243020

FIGURE 2.—*One of the numerous farms on easily erodable soils in southwestern Wisconsin seriously damaged by runoff following clearing of timber from steep slopes.*

made in improving farming methods, but very little in restoring a suitable protective cover on the steep upper slopes (fig. 2).

Economic and Industrial Conditions

Area and Population

The Lake States region covers 122.7 million land acres, or approximately 6 percent of the area of the continental United States. The three States together are about the size of Sweden.

The 1947 population was about 12.2 million, which was 8.5 percent of the United States total. It is rather significant from a timber-marketing standpoint that, roughly, one-fourth of the population of the country lives within the region and six adjoining industrial and prairie States.

The region may be divided into three broad zones (fig. 3). The northern forest zone includes 43 percent of the region's land area, but has only 12 percent of its population. The southern forest zone, which is predominantly farm woods, has 40 percent of the land area and 82 percent of the population, nearly half of whom reside in three metropolitan areas—Detroit, Milwaukee, and Minneapolis-St. Paul. The prairie zone covers about 17 percent of the land and has 6 percent of the population.

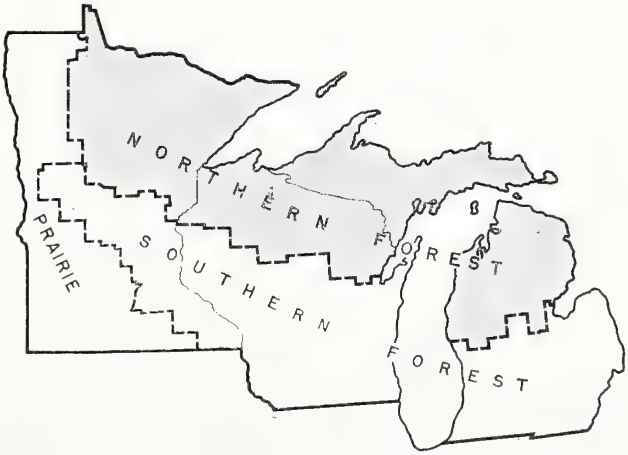


FIGURE 3.—*Principal forest zones in the Lake States region.*

Agriculture

Sixty-one percent of the land area of the region is in farms; approximately 38 percent is cropped.

Most of the region is in the northeastern dairy belt. Southern Minnesota and a few southern counties of Michigan and Wisconsin are within the central corn belt. Western Minnesota is part of the northern Great Plains wheat and small grains area.

Major crops are dairy products, grains, pork, potatoes, fruit and vegetables, soybeans, flax, and seed crops.

The southern and prairie zones contain nearly nine-tenths of the cropland. Farms here are comparable in most respects to those in northern Iowa, Illinois, and Indiana. The average farm in 1940 contained about 112 acres, or approximately three forties, of which 27 acres were woods (*48*). Today the average farm is a little larger, the average wood lot probably a little smaller. The wood lots characteristically occupy land that is too rough, too stony, too sandy, or too wet to make good crop or pasture. They also exist on limited areas of level or gently rolling loam soils suitable for cropping, but most of these are being cleared.

The northern cut-over counties have developed more slowly in agricultural lines. Twenty-seven percent of the land is in farm ownership; but only 10 percent is cropped (*36*). Value of cash crops is relatively low and a considerable portion of the settlers seek supplemental income from mining, woods work, fishing, trapping, and tourist business (*3, 18, 34, 42, 46*).

Industry

The leading manufacturing industries in the Lake States region are these general types:

1. Those making machinery, including automobiles, trucks, tractors, motors, and agricultural implements. Plants are largely concentrated in major industrial centers in the southern part of the region.

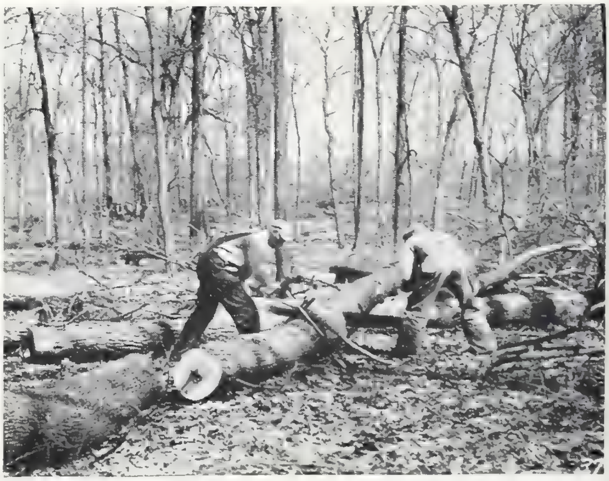
2. Those processing food, such as flour milling, meat packing, brewing, and canning. These are scattered throughout the farming sections of the States

3. Those turning out miscellaneous consumer goods, such as textiles, pottery, aluminum ware, furniture, refrigerators, and footwear. These, likewise, are mostly in the south.

4. Those connected with extracting, processing, and transporting natural resources—iron, copper, and other ores; lumber, pulpwood, and other forest products; commercial fish. These are, to a large extent, in the northern part of the region.

Primary forest industries make up a relatively small proportion of the total in terms of employment and dollar value, but they are of extreme importance in the northern part of the region. Without the industrial pay rolls, the job opportunities for local settlers, the freight tonnage, etc., created by forest industries, people in many small cities, villages, and farming communities in the north could not maintain a satisfactory standard of living. Without the tax revenue from wood-using plants and forest lands, counties such as Koochiching in Minnesota, Forest in Wisconsin, and Alger in Michigan, would find it difficult if not impossible to maintain satisfactory roads, schools, and other public services (*14, 15, 31*).

One of the major values of small forest industries is the part-time employment given to settlers in districts where full-time commercial agriculture is not practicable (*2, 6*), (fig. 4). Even in the main farming districts, winter work in the woods or in portable sawmills offers a useful supplement to regular farm work. Moreover, the local industries provide cheaper building material (*43*), and the fuel wood and posts obtained from local woods operations often reduce the farmer's cash outlay by hundreds of dollars (*48*).



F—377035

FIGURE 4.—*Farmers in some parts of the Lake States depend upon work in the woods and nearby mills for a large part of their cash income.*

Major Forestry Problems

Liquidation of virgin timber, closing of large sawmills and logging camps, and subsequent shifts in landownership have led to some serious economic difficulties in parts of the region.

Not only the counties and other local units of government, but the States as well, have been affected by declining revenue from forest lands and forest industries. Also, the States have had to absorb some of the bond indebtedness of cut-over taxing districts, and to provide large aids for education, roads, and relief (*12, 17, 25, 35*). These burdens have impaired the ability of States and units of local government to engage in full-scale forest management.

The present mixed pattern of forest ownership complicates the job of initiating sustained-yield forest management; that is, management of timberlands for steady and more or less equal annual yields coordinated with the needs of dependent industries.

Public agencies, although holding large acreages of cut-over land, do not have their properties well consolidated; they lack control of strategic areas needed to round out sustained-yield management units.

Forest industries, with a very few exceptions, do not control sufficient timberland to operate independently on a sustained-yield basis. Large lumber companies continue to drop out as their timber holdings disappear. Pulp companies and most other wood-using industries are dependent upon purchases of wood and stumpage for the greater part of their requirements.

Thousands of individuals—farmers, summer home owners, speculators, and others—plus a few large mining companies and estates, control most of the privately owned timberland in the Lake States. They have a wide variety of aims, and very few have been interested in timber growing as a business.

On the utilization side, the region has excess mill capacity in industries consuming favored species, a condition which leads to intensive competition for certain woods, high prices, and overcutting in the forest. It has too few industries adapted to use the species and sizes of timber now available in surplus quantities, or to salvage woods and mill waste.

To be able to deal with these complex and difficult problems intelligently, and to initiate a program for forest improvement, people in the Lake States will need specific information on (1) what the significant facts are as to the present condition of forest lands, the quantities of timber remaining, the present rate of cutting, and present rate of growth; (2) who owns this timber and how the owners treat it; (3) what the wood-using industries amount to, and how much of a drain they make on the forest now and prospectively; and (4) the present and estimated requirements for forest products in this region.

With these facts as a background, the people of the Lake States will be able to find an approximate answer to these two major questions:

1. *What is a logical goal in timber production in the Lake States?* In dealing with this, they must give consideration to the region's relation to other wood-producing regions and to large wood-consuming centers as well as to the needs of the Lake States region itself. They must also seek a balance between present and future needs for forest products and a balance between commodity requirements and other forest services. Moreover, they must keep their aims within the bounds of financial feasibility.

2. *What forestry practices will be needed to accomplish the proposed goal within a reasonable period of time?* Some steps will be necessary to build up the growing stock and establish a balanced division of age classes so that future yields will be not only larger but also steady from year to year and consist of the species and kinds of wood desired.

Forest Inventory

Areas

FORESTS once covered 103.7 million acres (*37*), nearly 85 percent of the land area of the Lake States region. Today they occupy 54.7 million acres, or 45 percent (table 1).

Only 50 million acres of the present forest area is commercial forest. The other 4.7 million acres is practically unavailable for timber production, either because it has poor drainage and other features which preclude growing merchantable sawlogs and pulpwood, or because it has been reserved for parks and other exclusive use.

Commercial Forest

The condition of the commercial forest land with respect to size, species, and quality of timber, as well as ownership, will determine to a large extent the prospects for timber production during the next 40 to 50 years. Therefore, this land deserves rather careful examination.

TABLE 1.—*Area of forest land, by broad classification, in relation to total land area in the Lake States region, 1950*

Kind of land	Region total	Minnesota	Wisconsin	Michigan
	Thousand acres	*Thousand acres*	*Thousand acres*	*Thousand acres*
Total land area [1]	122,718	51,206	35,018	36,494
Commercial forest [2]	50,000	17,000	15,200	17,800
Noncommercial forest (scrub)[3]	3,400	2,100	600	700
Reserved forest: [4]				
Commercial quality	900	450	60	390
Noncommercial quality	400	150	140	110
Total, all forest [5]	54,700	19,700	16,000	19,000
Nonforest area	68,018	31,506	19,018	17,494

[1] From U. S. Census of Agriculture: 1945, v. 1, pt. 6–8.

[2] Land bearing or capable of bearing timber of commercial character and economically available now or prospectively for commercial use and not withdrawn from such use.

[3] Lands which appear to be permanently out of commercial timber-producing class, owing to very low productivity, excessively poor quality of timber, or extreme inaccessibility. This consists largely of bogs incapable of producing commercial saw timber or pulpwood in 100 years.

[4] Land withdrawn from commercial use for parks, preserves, wilderness areas, etc.

[5] Land bearing forest growth or land from which the forest has been removed but which shows evidence of past forest occupancy and is not now in other use. Excludes woodlands within city limits.

STAND CLASSES

For sustained timber yields, a forest should be made up of trees of all ages and stages of development from seedlings to mature timber, in such proportions that when one mature group of trees is harvested, another is ready to take its place. The present Lake States forests do not meet this requirement.

Only a very small remnant of the original virgin forest remains, and relatively small areas of second growth have reached saw-timber size. Nearly nine-tenths of the land supports second growth from seedling to pole size—some in very poorly stocked stands (table 2). In other words, they have too little mature and near-mature timber, and far too

TABLE 2.—*Area of commercial forest land in the Lake States region, by stand class, 1950*

Stand class	Region total	Minnesota	Wisconsin	Michigan
	Thousand acres	*Thousand acres*	*Thousand acres*	*Thousand acres*
Old-growth saw timber [1]	1,500	200	300	1,000
Second-growth saw timber [2]	4,400	1,400	1,500	1,500
Pole timber[3]	9,600	2,900	2,900	3,800
Seedlings and saplings [4]	22,000	7,400	6,900	7,700
Poorly stocked and deforested [5]	**12,500**	5,100	3,600	3,800
Total	50,000	17,000	15,200	17,800

[1] Saw-timber stands (1,500 board feet or more per acre by International ¼-inch rule) in which more than 50 percent of the net board-foot volume is in old-growth saw-timber trees; i. e., trees that have reached or passed the age of physiological maturity. Does not include any of the pulpwood types—jack pine, aspen, spruce-fir, etc. The limited areas of saw-timber size in these types are included with second growth regardless of age or condition.

[2] Saw-timber stands other than old growth.

[3] Stands failing to meet the saw-timber stand classification but at least 10-percent stocked with trees pole-sized and larger (5.0 inches d.b.h. and larger) and with at least half the minimum stocking in pole-size trees. No stands included in this class with less than 3 cords per acre of live, merchantable timber.

[4] Stands not qualifying in any of the above classes, but having at least 40-percent stocking mostly of seedlings and saplings of commercial tree species, less than 5.0 inches d.b.h.

[5] *Poorly stocked areas* are seedling or sapling stands with 10- to 39-percent stocking of young trees; they may include some scattered trees of saw-timber or pole size, but not enough to be considered as belonging in one of the larger size classes. *Deforested areas* are forest lands less than 10-percent stocked with trees of commercial species.

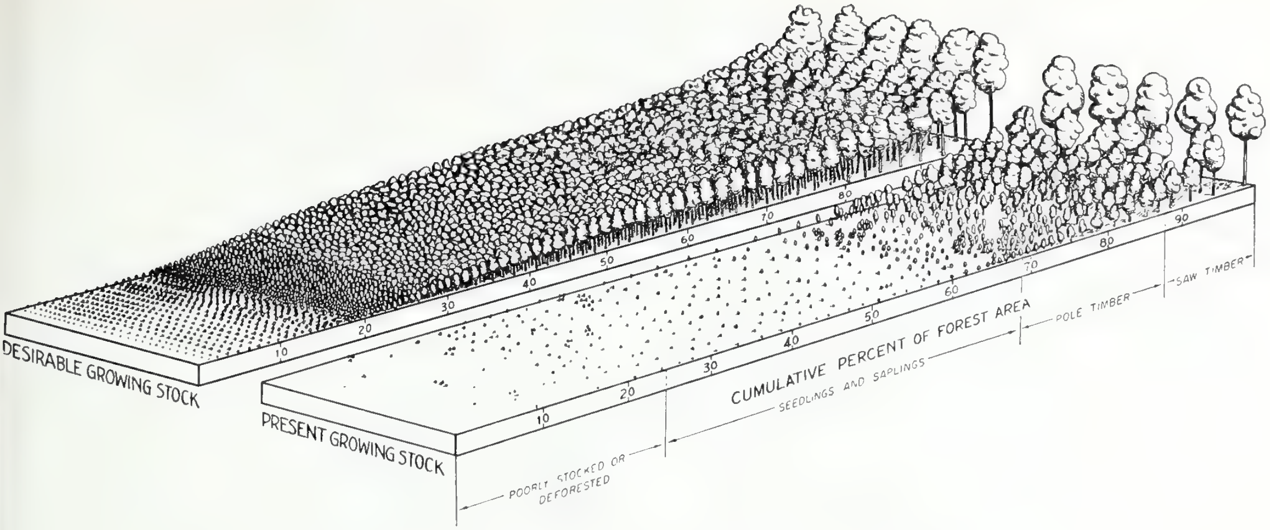


Figure 5.—*Comparison of present stand-class areas with desirable pattern.*

much immature timber, too many stands are poorly stocked, and there is too much deforested land (fig. 5).

PRESENT FOREST TYPES

The forests of this region are made up of 50 or more common tree species mixed in various combinations. For simplicity they are described under four forest type groups (table 3).

Northern pine group: The northern pine types consist of white pine, red pine, and jack pine, three commonly recognized forest types (table 4).

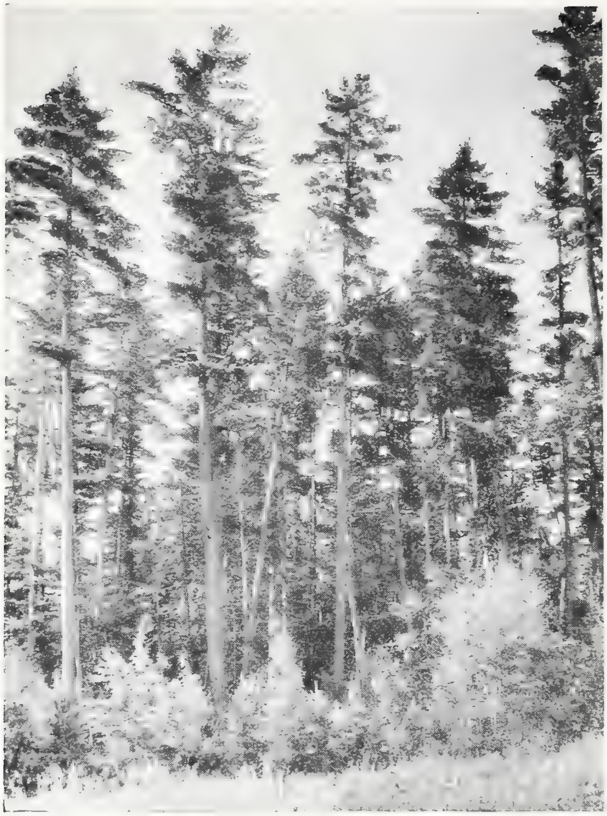
The once prominent white pine type (*30*) now occupies only 2 percent of the forest land. Only scattered remnants of the virgin forest remain (fig. 6). Natural reproduction is not extensive and very little nursery stock is being planted because of prevalence of white pine weevil, blister rust, and other natural enemies. On the other hand, scattered white pine trees occur rather commonly in other types and with care may gradually extend the range of the type (fig. 7).

Table 3.—*Area of commercial forest land in the Lake States region, by forest type groups, 1950*

Forest type group	Region total	Minnesota	Wisconsin	Michigan
	Thousand acres	*Thousand acres*	*Thousand acres*	*Thousand acres*
Northern pine	4,400	1,650	1,250	1,500
Spruce-fir	9,800	4,750	1,900	3,150
Hardwoods (except aspen)	16,300	3,000	6,150	7,150
Aspen	19,500	7,600	5,900	6,000
Total	50,000	17,000	15,200	17,800

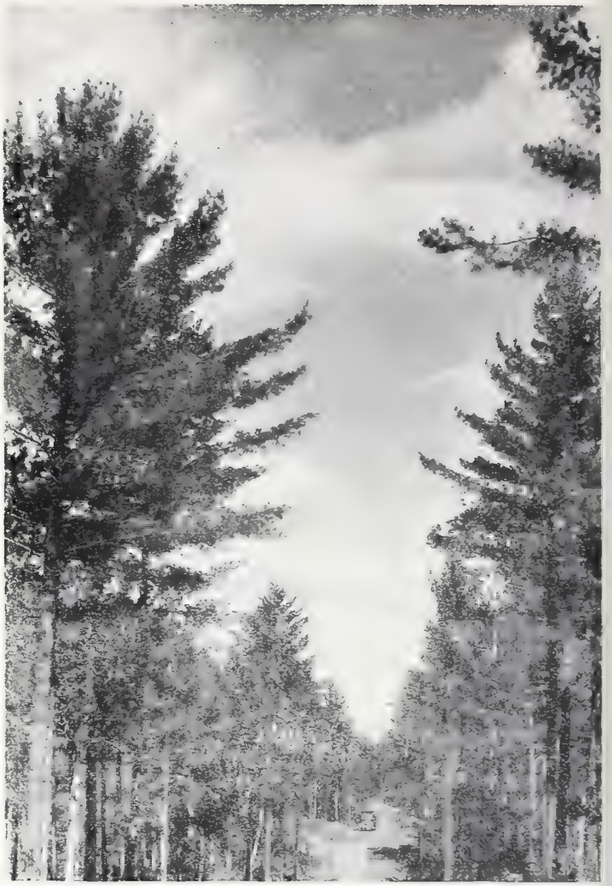
Table 4.—*Area of northern pine types in the Lake States region, by stand class, 1950*

Stand class	Region total	Minnesota	Wisconsin	Michigan
	Thousand acres	*Thousand acres*	*Thousand acres*	*Thousand acres*
ALL PINE TYPES				
Saw timber	550	290	130	130
Pole timber	780	380	180	220
Seedlings and saplings	1,770	560	550	660
Poorly stocked	1,300	420	390	490
Total	4,400	1,650	1,250	1,500
WHITE PINE				
Saw timber	230	80	80	70
Pole timber	100	20	40	40
Seedlings and saplings	220	60	80	80
Poorly stocked	550	140	230	180
Total	1,100	300	430	370
RED PINE				
Saw timber	120	50	30	40
Pole timber	80	30	25	25
Seedlings and saplings	350	90	125	135
Poorly stocked	250	80	90	80
Total	800	250	270	280
JACK PINE				
Saw timber	200	160	20	20
Pole timber	600	330	115	155
Seedlings and saplings	1,200	410	345	445
Poorly stocked	500	200	70	230
Total	2,500	1,100	550	850



F—243286

FIGURE 6.—*Remnant of virgin white and red pine in Michigan: Hartwick Pines State Park. Only small scattered tracts of this kind of timber remain in the region.*



F—433097

FIGURE 7.—*Second-growth white pine on Superior National Forest, Minn. Acreage of pure type is very limited but scattered white pine trees are found in other types.*

The red pine type, occurring mostly in seedling and sapling stands, now occupies less than 1 million acres. However, it is being planted more extensively than white pine (fig. 8), and in some localities is replacing jack pine through process of natural conversion (*11*).

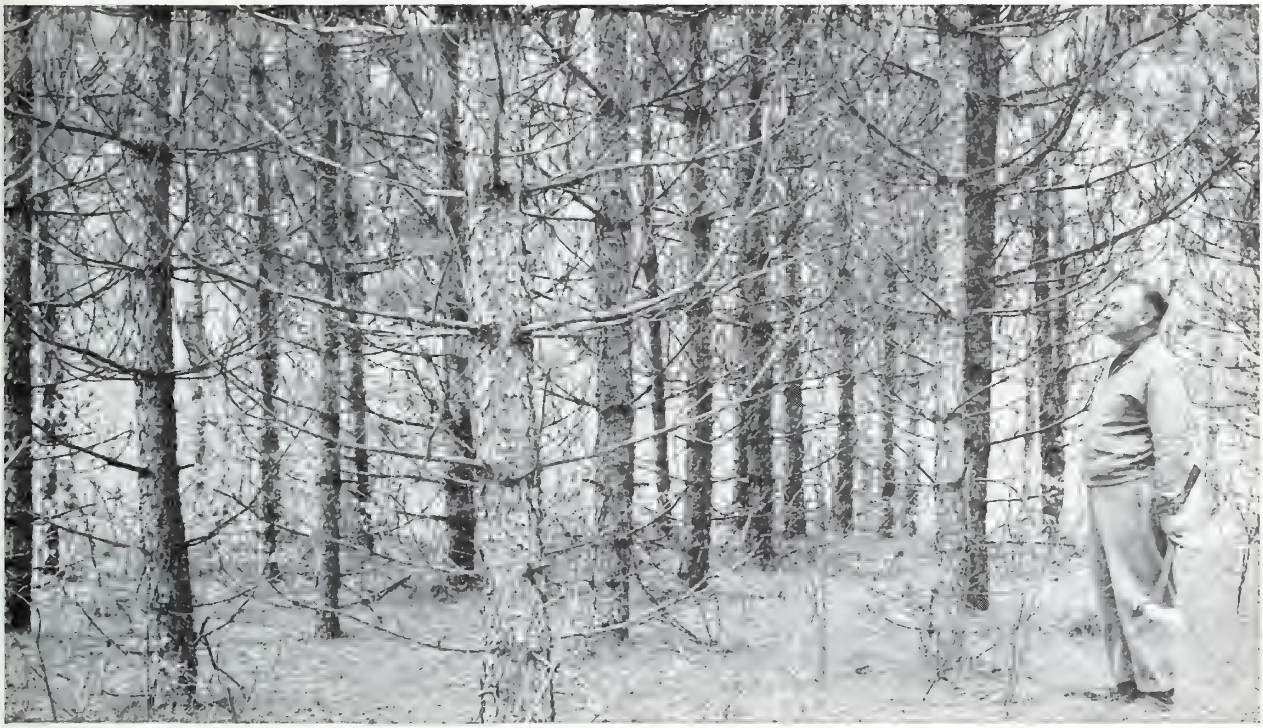
The jack pine type has supplanted white and red pine on sandier soils (*10*) and now occupies more land than the two other pine types combined. Most of the jack pine stands still are immature (fig. 9), and some are very poorly stocked.

Spruce-fir group: This group is divided into four forest types (table 5):

The white spruce–balsam fir type occurs on moist upland sites and swamp margins in the northern part of the region. Balsam fir is the key species. Aspen, paper birch, and other hardwoods commonly have supplanted the white spruce in second-growth stands (fig. 10).

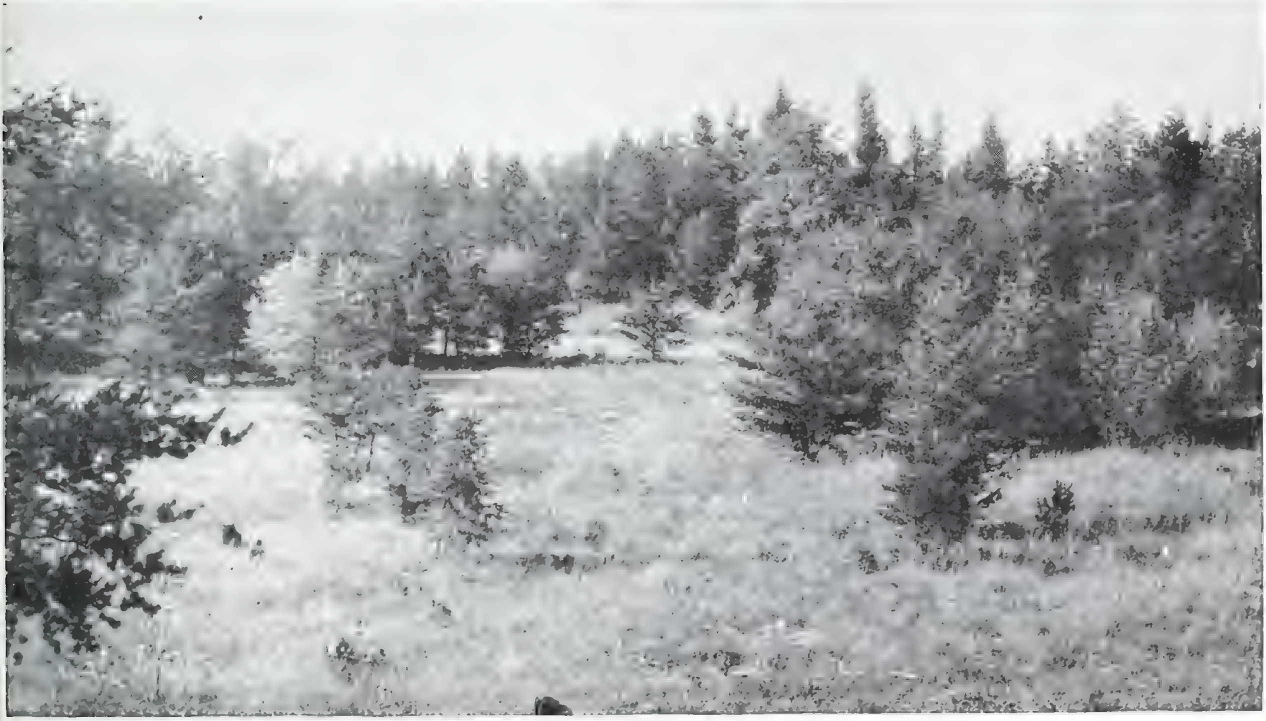
The black spruce type occurs primarily in peat swamps where conditions for tree growth are rather unfavorable (*19*). However, because of the high demand for the species for pulp, the type is one of the more valuable in the region. Around swamp margins, black spruce grows fairly rapidly and some 100 thousand acres in such situation can be classed as small saw-timber stands. Toward the center of the swamps, the growing conditions become less favorable and most stands mature at pole-timber size (fig. 11). Under the worst drainage and climatic conditions, the black spruce will not yield merchantable crops of pulpwood at 100 years of age (fig. 12), and consequently such stands have been classified as noncommercial.

The tamarack type occupies sites similar to those for black spruce, but it is less extensive. Tamarack is valued primarily as a mine-timber and fence-post wood, although it has been pulped to a limited extent.



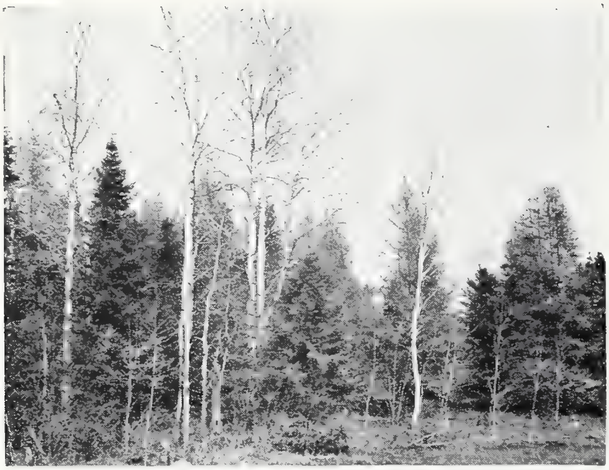
F—434953

FIGURE 8.—*Twenty-seven-year-old red pine plantation in Minnesota. Several hundred thousand acres of this type have been planted in the region.*



F—372187

FIGURE 9.—*Jack pine seedlings and saplings in Michigan. Because of incomplete stocking, trees often develop rather short and limby*



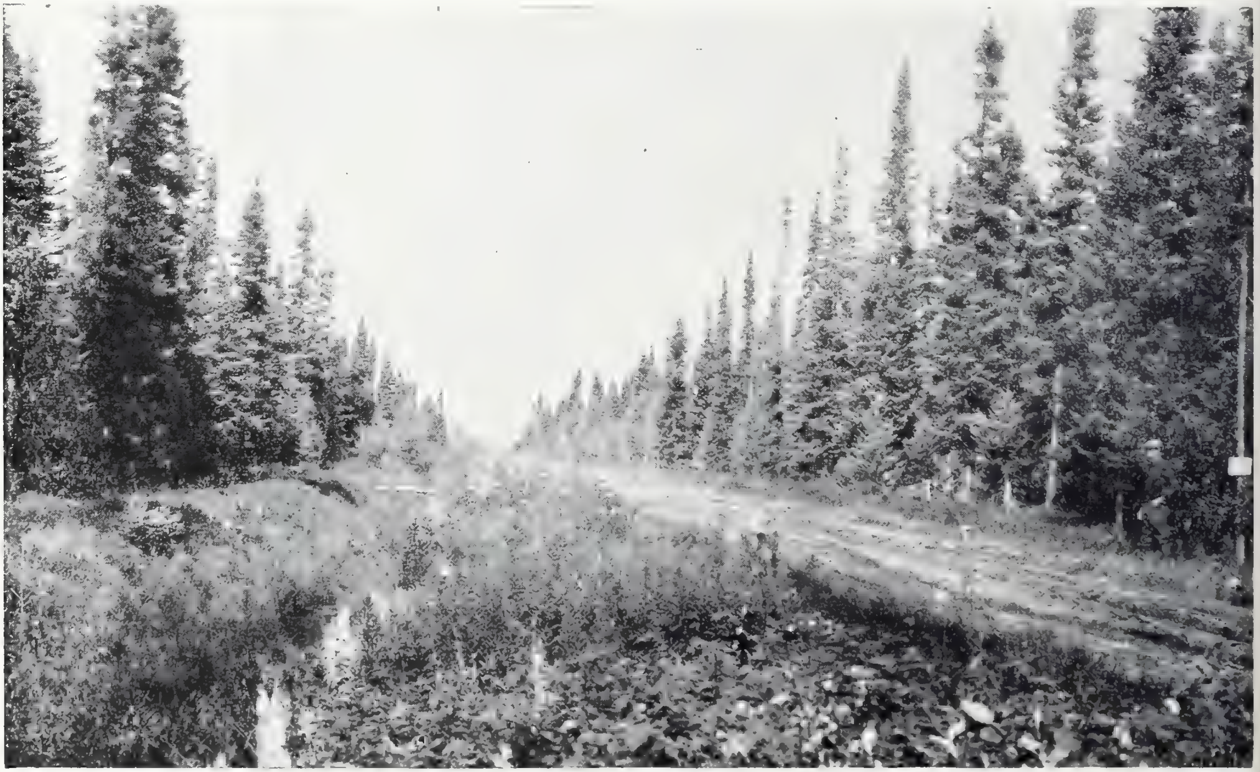
F—380692

FIGURE 10.—*Typical second growth of white spruce–balsam fir type, in which balsam fir is the key species with a conglomeration of other species.*

The cedar type occurs both on peat swamps and moist upland areas in the northern part of the region. The type originally was valued as a producer of telegraph and telephone poles. In its second-growth phase, it yields chiefly fence posts and mine lagging. Most of the type now is in the restocking or sapling stage.

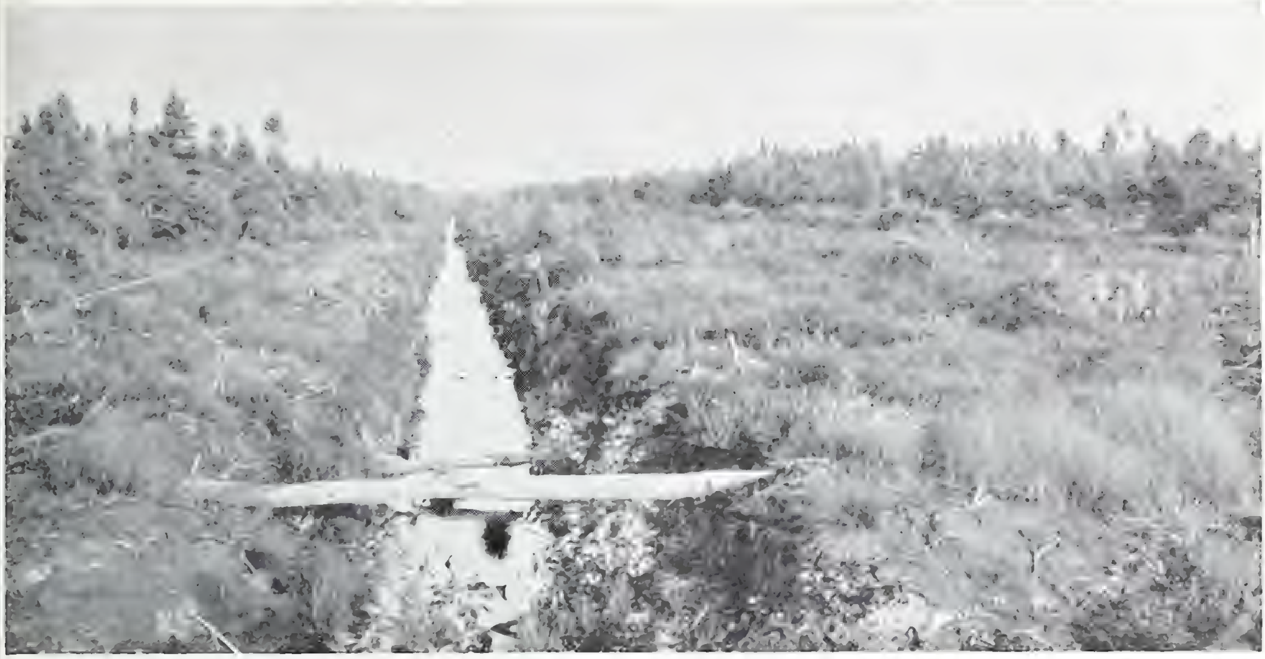
Hardwood group: Three distinct types (table 6):

The northern hardwood type, characteristically composed of sugar maple, yellow birch, basswood, beech, and hemlock, occurs principally on loamy upland soils in the northern part of the region. The old-growth stands, mostly in northern Michigan, contain trees ranging in age from 160 to 300 years or more, in diameter from 18 to 30 inches, in height from 80 to 100 feet (fig. 13). Second-growth saw-timber forests, commonly residual stands from heavy partial logging, often include a disproportionate share of inferior species and cull trees. The pole stands and sapling areas, likewise, contain scattered saw-timber trees left at time of logging, but are made up mainly of young trees of more or less even age. The northern hardwood type will respond promptly to improved forest management—the mature stands to selective logging, the second-growth stands to salvage operations and improvement cuttings, the restocking lands to sustained protection (*9, 32, 33, 47*). The type does not require much artificial reforestation.



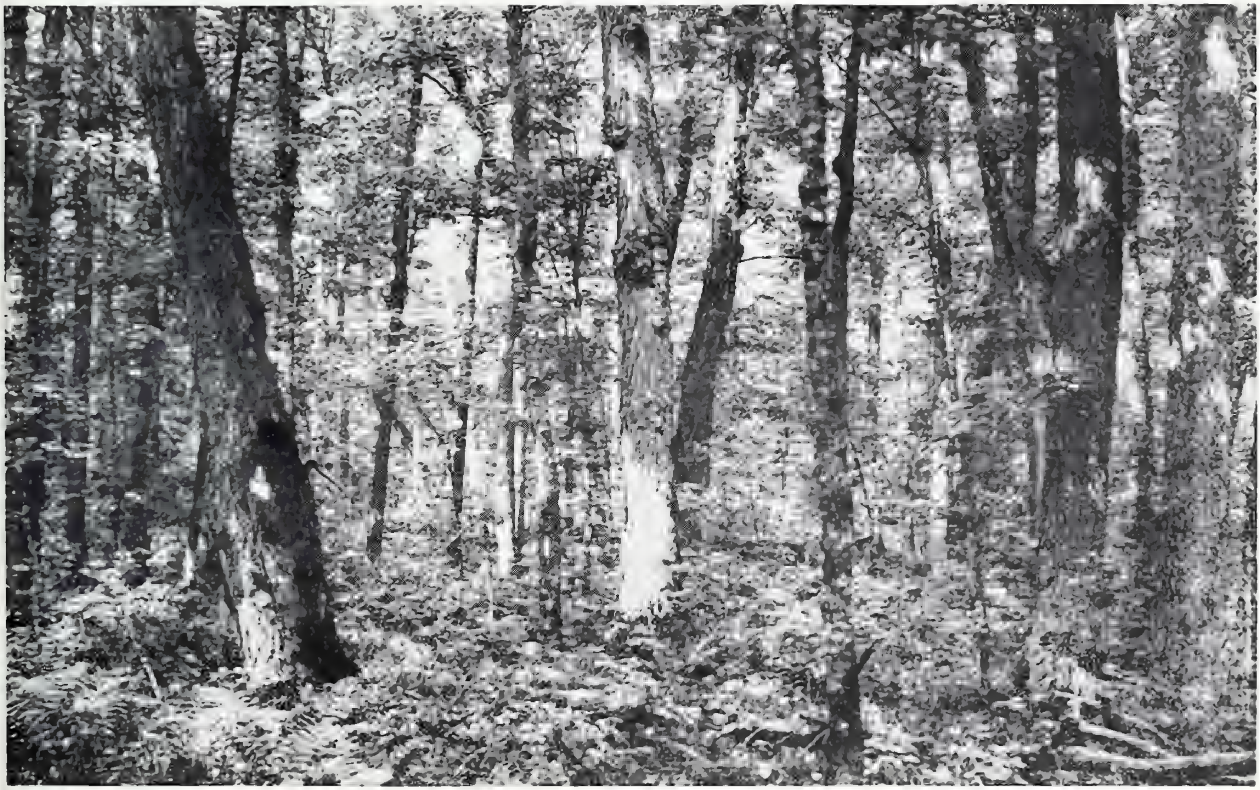
F—230554

FIGURE 11.—*Black spruce pole stand growing in peat bog in northern Minnesota. Stands such as this are logged for pulpwood during winter.*



F—231076

FIGURE 12.—*Black spruce growing on poor site in Minnesota. Such stands will not produce 3 cords of pulpwood per acre at 100 years of age and are classified noncommercial.*



F—243073

FIGURE 13.—*Old-growth northern hardwood forest of sugar maple, yellow birch, and basswood in the Upper Peninsula of Michigan. Three overmature, decadent trees appear in foreground.*

TABLE 5.—*Area of spruce–fir types in the Lake States region, by stand class, 1950*

ALL SPRUCE—FIR TYPES

Stand class	Region total	Minnesota	Wisconsin	Michigan
	Thousand acres	*Thousand acres*	*Thousand acres*	*Thousand acres*
Saw timber	670	270	70	330
Pole timber	1,970	890	310	770
Seedlings and saplings	3,680	1,720	650	1,310
Poorly stocked	3,480	1,870	870	740
Total	9,800	4,750	1,900	3,150

WHITE SPRUCE—BALSAM FIR

Stand class	Region total	Minnesota	Wisconsin	Michigan
Saw timber	400	140	50	210
Pole timber	870	280	190	400
Seedlings and saplings	1,430	500	320	610
Poorly stocked	800	280	240	280
Total	3,500	1,200	800	1,500

BLACK SPRUCE

Stand class	Region total	Minnesota	Wisconsin	Michigan
Saw timber	100	70		30
Pole timber	500	350	50	100
Seedlings and saplings	1,200	750	150	300
Poorly stocked	1,300	830	300	170
Total	3,100	2,000	500	600

TAMARACK

Stand class	Region total	Minnesota	Wisconsin	Michigan
Saw timber	30	20		10
Pole timber	300	150	30	120
Seedlings and saplings	440	270	90	80
Poorly stocked	830	560	180	90
Total	1,600	1,000	300	300

CEDAR

Stand class	Region total	Minnesota	Wisconsin	Michigan
Saw timber	140	40	20	80
Pole timber	300	110	40	150
Seedlings and saplings	610	200	90	320
Poorly stocked	550	200	150	200
Total	1,600	550	300	750

TABLE 6.—*Area of hardwood types (except aspen) in the Lake States region, by stand class, 1950*

ALL HARDWOODS

Stand class	Region total	Minnesota	Wisconsin	Michigan
	Thousand acres	*Thousand acres*	*Thousand acres*	*Thousand acres*
Saw timber	3,480	490	1,300	1,690
Pole timber	3,150	480	1,310	1,360
Seedlings and saplings	5,550	820	2,200	2,530
Poorly stocked	4,120	1,210	1,340	1,570
Total	16,300	3,000	6,150	7,150

NORTHERN HARDWOOD

Stand class	Region total	Minnesota	Wisconsin	Michigan
Saw timber	2,200	250	570	1,380
Pole timber	1,700	200	650	850
Seedlings and saplings	4,000	400	1,500	2,100
Poorly stocked	1,500	350	480	670
Total	9,400	1,200	3,200	5,000

OAK-HICKORY

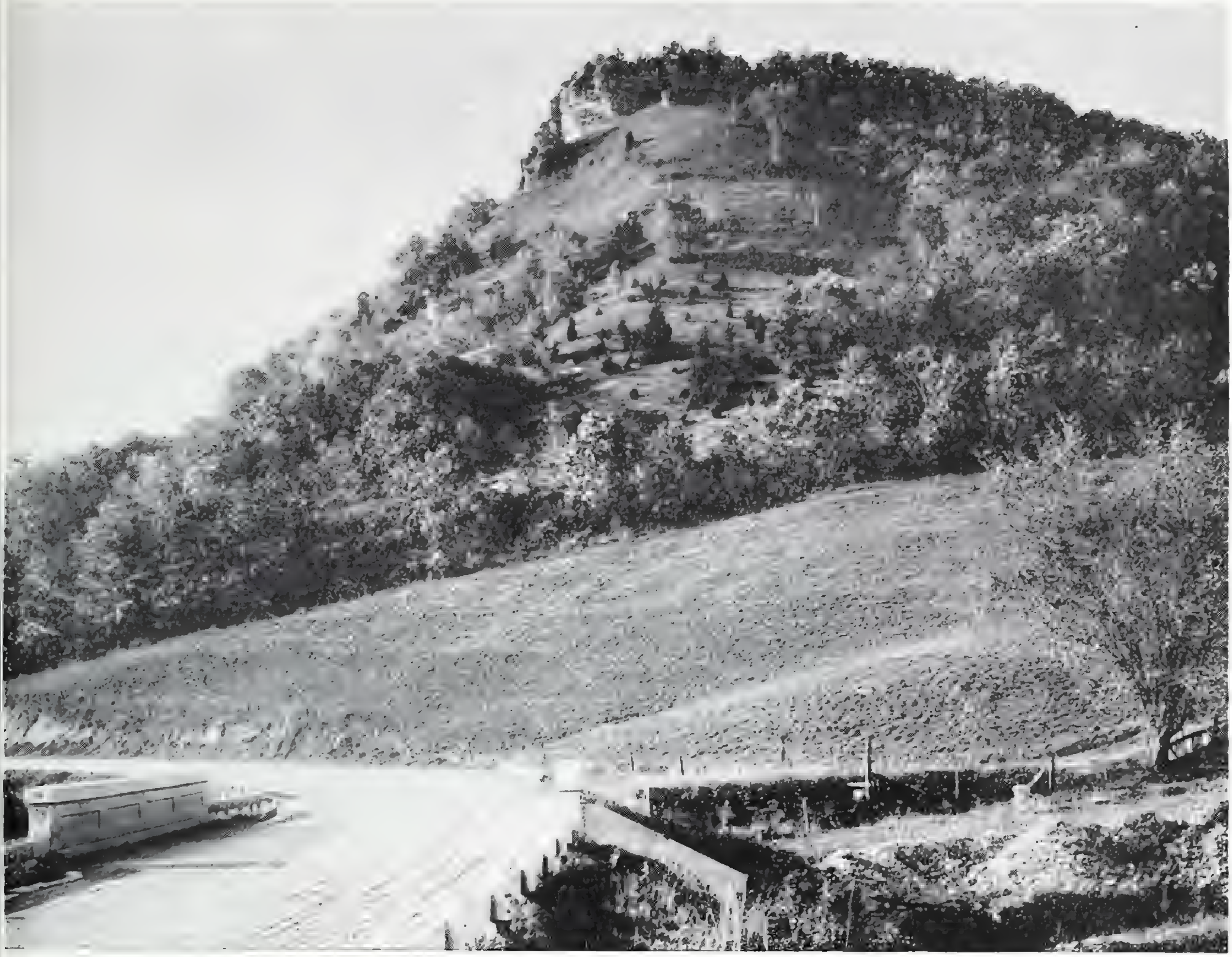
Stand class	Region total	Minnesota	Wisconsin	Michigan
Saw timber	700	90	510	100
Pole timber	800	130	420	250
Seedlings and saplings	850	170	480	200
Poorly stocked	1,550	510	440	600
Total	3,900	900	1,850	1,150

ASH-ELM

Stand class	Region total	Minnesota	Wisconsin	Michigan
Saw timber	580	150	220	210
Pole timber	650	150	240	260
Seedlings and saplings	700	250	220	230
Poorly stocked	1,070	350	420	300
Total	3,000	900	1,100	1,000

The oak–hickory type in the southern part of the region includes a wide range of sites and conditions. Mixed red and white oaks on rolling loamy soils in Wisconsin and Michigan make up the best oak forests. The scrub oak mixtures on sandy lands and open-grown bur oak groves around the prairie margins are the poorest. The hickory component is of little significance in this region. The type, as a whole, has been so badly treated in logging, pasturing, burning, and land clearing that most of it is in very poor condition. Typically, it is made up of open stands with inadequate understory of seedlings and saplings (fig. 14). It will require intelligent cultivation over an extended period to regain full productivity.

The ash–elm hardwood type covers 3 million acres of stream bottoms, swamp borders, and poorly drained uplands in various parts of the region. The saw-timber stands consist for the most part of large American elm, but include some groves of cottonwood and some representation of black ash, yellow birch, and basswood. The pole and sapling stands commonly include also green ash, balm-of-Gilead, red maple, silver maple, boxelder, black willow, and butternut. The type has been seriously deteriorated in many places by repeated culling; that is, removal of more valuable trees while leaving defective ones and those of inferior species in possesion of the land (fig. 15).



F—243320

FIGURE 14.—*Oak–hickory forest in southwestern Wisconsin. Heavy pasturing has eliminated almost all reproduction.*

Aspen: Aspen type presumably covered a very limited area in the original forest—woodland borders and accidental openings in the forest. Today, however, it occupies 19.5 million acres, nearly two-fifths of the entire commercial forest area (table 7).

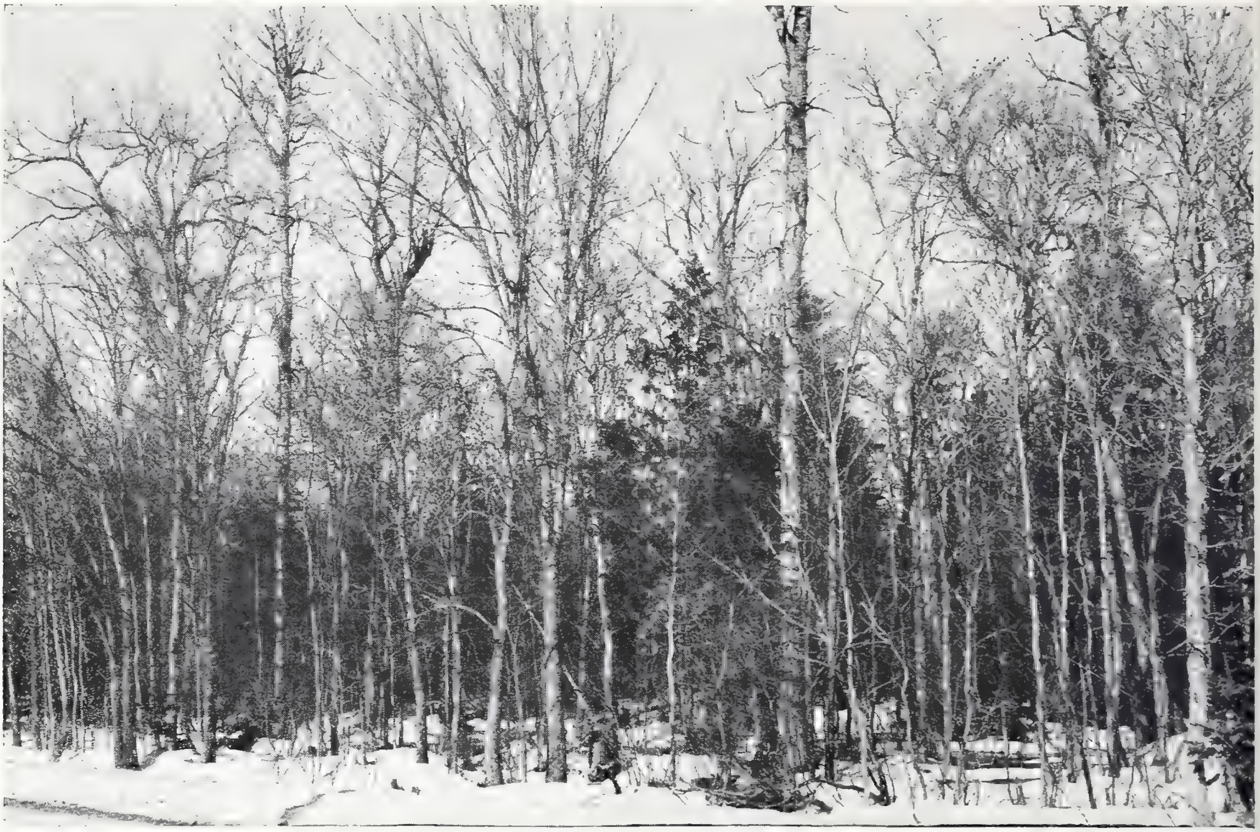
Some of the aspen forest is producing timber of a quality suitable for box lumber, pulpwood, etc., and at a fairly rapid rate. It may well be maintained indefinitely as aspen type (*28*). The greater part of the area, however, would be more productive if restored to its original type.

TABLE 7.—*Area of aspen type in the Lake States region, by stand class, 1950*

Stand class	Region total	Minnesota	Wisconsin	Michigan
	Thousand acres	*Thousand acres*	*Thousand acres*	*Thousand acres*
Saw timber	1,200	550	300	350
Pole timber	3,700	1,150	1,100	1,450
Seedlings and saplings	11,000	4,300	3,500	3,200
Poorly stocked and deforested	3,600	1,600	1,000	1,000
Total	19,500	7,600	5,900	6,000

POTENTIAL FOREST TYPES

The present extent of pine, spruce–fir, and hardwood forest does not indicate fully the area available for producing valuable timber in this region. Under good management, many areas now occupied by grass, brush, and poor aspen can be restored to better types (fig. 16).



F—445444

FIGURE 15.—*Ash–elm forest on overflow land near the Presque Isle River in the Upper Peninsula of Michigan. Many of the larger trees are deformed or defective.*

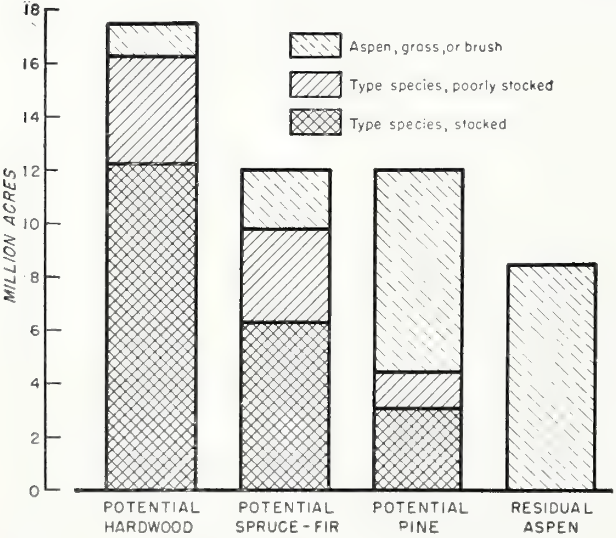


FIGURE 16.—*Potential area of major type groups, showing proportions now poorly stocked or covered with aspen, grass, and brush. Some of the aspen areas, if well protected, will convert naturally to the types indicated; others will need to be planted.*

Pine forests covered at one time about 24 million acres in the Lake States, not including the mixed types where white pine was an important component. In the development of the region, about half the original area was cleared and put to other uses. But approximately 12 million acres of potential pine land remains, fairly evenly divided among the three States, Presently, about two-thirds of this is occupied by aspen, grass, or brush. Aspen does not thrive on dry sandy soils; thus, reconversion to pine is highly desirable. Unfortunately, the rate of natural conversion is slow. With present relatively good fire protection, the rate of reseeding to pine should accelerate, but not enough to insure complete conversion, without considerable planting (fig. 17).

Forests of spruce, balsam fir, tamarack, and cedar once covered about 27 million acres in the Lake States. Roughly, 11 million acres have been diverted to nonforest uses, and 4 million acres have been converted more or less permanently into aspen

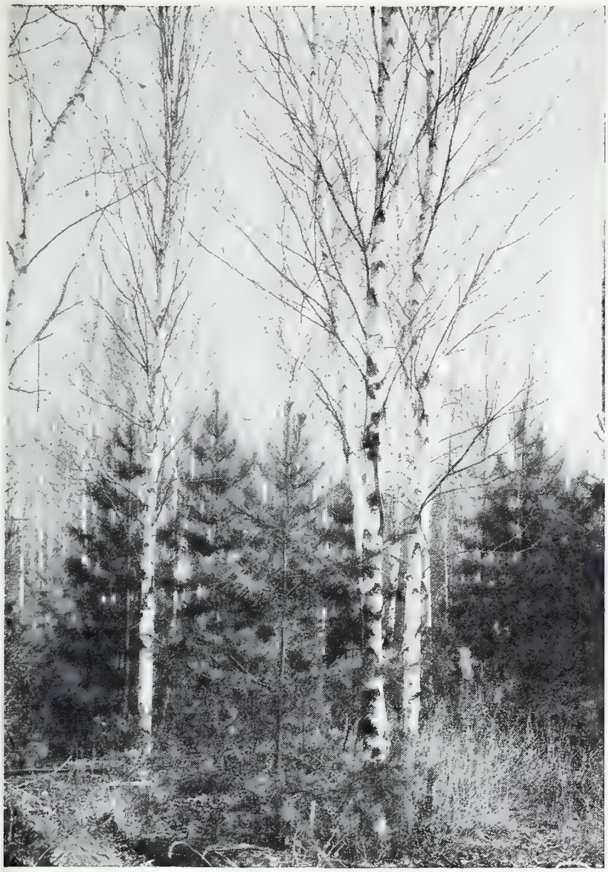

F—273309

FIGURE 17.—*Some aspen (and paper birch) areas have an understory of pine seedlings and saplings, but on most of this natural pine land natural conversion is progressing slowly.*

and brush types. This leaves 12 million acres of potential spruce–fir land, about half of it in Minnesota. The prospects are good for natural conversion over a period of 50 years (fig. 18). However, the new forests will be largely balsam fir unless spruce is encouraged by planting.

In the original forest, hardwood types occupied about 46 million acres—24 million northern hardwood, 13 million oak–hickory, and 9 million bottomland types. About 24 million acres of this total has been cleared and devoted to other uses, and about 4.5 million may remain more or less permanently in aspen. This leaves a potential hardwood area of approximately 17.5 million acres. About 7.6 million acres is in Michigan and 6.5 million acres in Wisconsin.

Much of the aspen has an understory of maple, basswood, elm, and some other species. Eventually most of it will revert to other hardwoods unless cutting, burning, pasturing, or other activities interfere. Limited areas may require planting.

These potential conversions would leave approximately 8.5 million acres in aspen. Under good management this aspen land should produce large quantities of box bolts, pulpwood, fuel wood and some saw and veneer logs.

Noncommercial Forest

Forest lands too poor to produce saw timber or pulpwood in loggable quantities have been classified as noncommercial. These consist largely of swamplands covered with a scrubby growth of black spruce, tamarack, or aspen. They include some scrub oak savannas and limited areas of dune sand. Largest tracts are in Minnesota.

Forest land set aside for parks or other uses which preclude ordinary timber harvesting has been classified as reserved forest. The largest units are the "no-cut area" within the Superior "roadless area" (*24*) and Itasca State Park in Minnesota, Isle Royale National Park and Porcupine Mountain State Park in Michigan. Many small parks and military and other reservations make up the remainder.

The timber volumes and current and potential growth on these areas have not been included in the estimates given in this report.

Forest-land Ownership

The ownership pattern is beginning to crystallize in the Lake States although numerous adjustments still need to be made.

In 1920, less than 10 percent of the forest land in the region was in public ownership. The Federal Government in its national forests, Indian reservations, and other tracts held less than 2 million acres. The States retained only about 3 million acres of their huge land grants. County forests were virtually nonexistent.

Between 1925 and 1945, the States and counties took over about one-fourth of the privately owned forest lands through tax forfeiture. During the same period the Federal Government enlarged its holdings by about 6 million acres, mainly by purchases and exchanges (fig. 19). Currently, public agencies control about 44 percent of all forest land, 41 percent of the commercial forest area (table 8).

The newly acquired public forest areas consist largely of cut-over land. Thus, the holdings of the

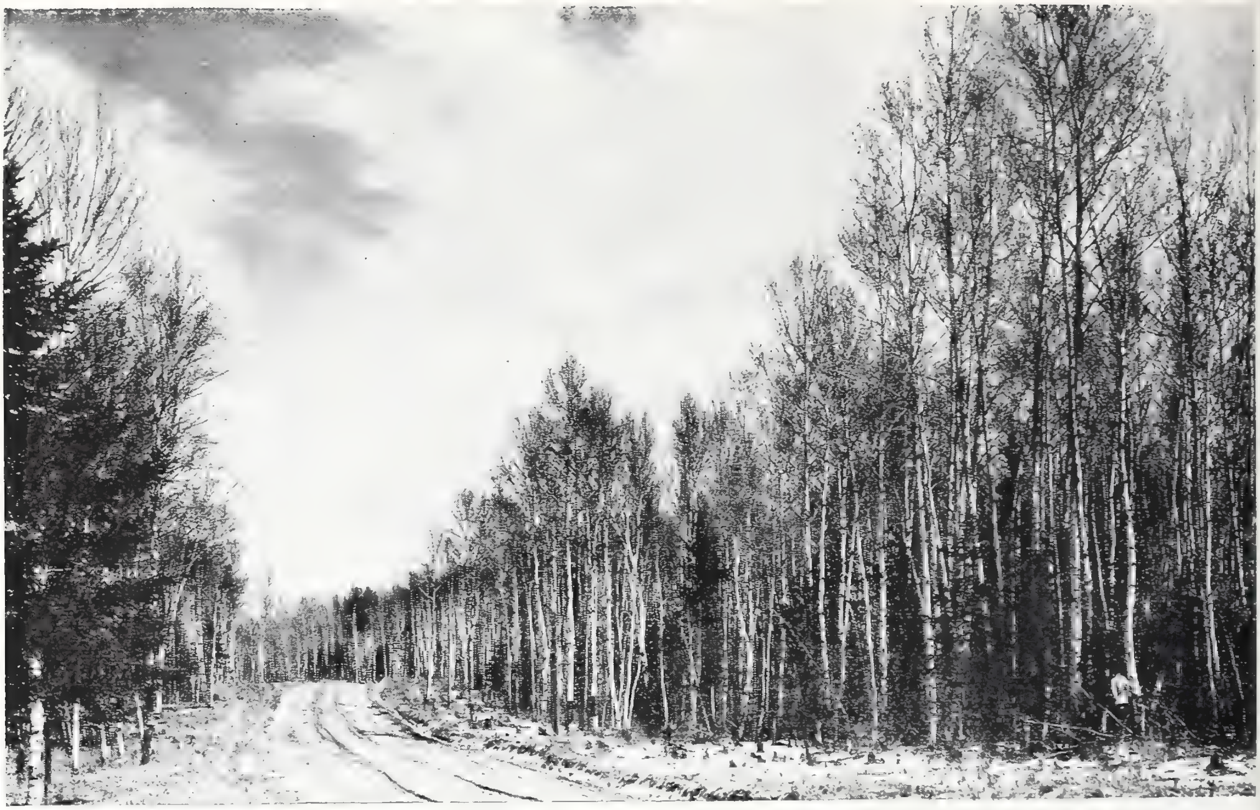

F—235986

FIGURE 18.—*About 2 million acres of aspen (and paper birch) growing on spruce–fir land has an understory of balsam fir, indicating a trend toward natural conversion.*

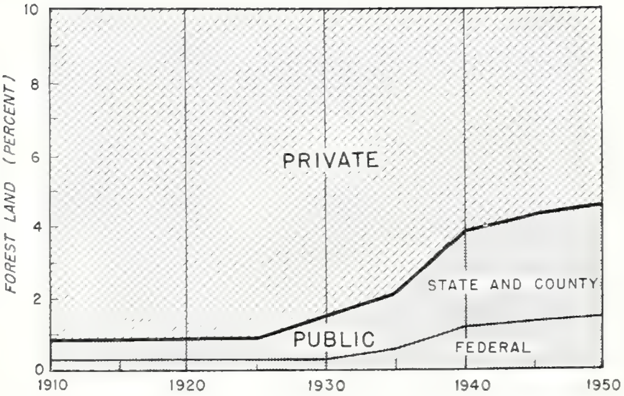


FIGURE 19.—*Trend in forest-land ownership, 1910–50.*

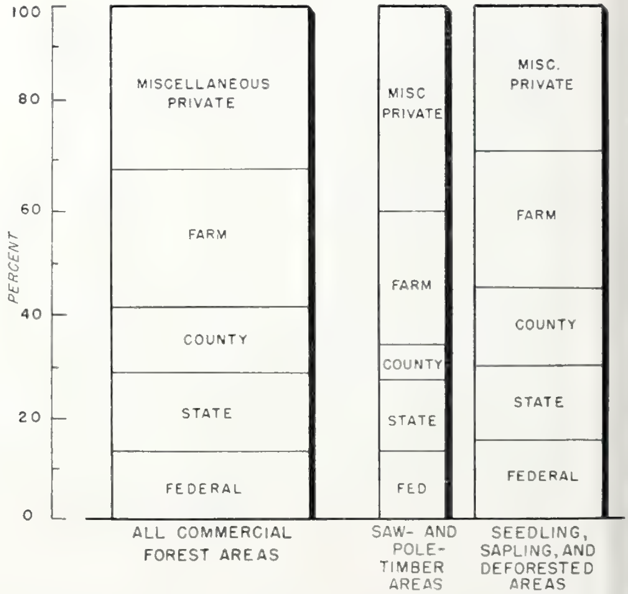


FIGURE 20.—*Division of commercial forest area among owne groups. Public agencies have relatively less merchantable timber, more cut-over land.*

Federal agencies, States, and counties contain less than a proportionate share of saw-timber and pole-timber stands (fig. 20, table 9).

The different classes of owners have a wide variety of aims in forest land management. Among the forest industries, some want to grow pulpwood, some sawlogs, some veneer bolts. Farmers often try

TABLE 8.—*Area of all forest land in the Lake States region, by ownership class and major use*

State	All owners	Federally owned or controlled				State	County or municipal	Private	
		Total	National forest, June 1947	Indian, 1945	Other			Farm	Other
	Thousand acres	*Thousand acres*	*Thousand acres*	*Thousand acres*	*Thousand acres*	*Thousand acres*	*Thousand acres*	*Thousand acres*	*Thousand acres*
ALL FOREST LAND									
Minnesota	19,700	3,700	2,565	860	275	4,100	4,300	4,600	3,000
Wisconsin	16,000	2,100	1,422	450	228	480	2,520	5,600	5,300
Michigan	19,000	2,500	2,213	25	262	4,320	80	3,700	8,400
Region total	54,700	8,300	6,200	1,335	765	8,900	6,900	13,900	16,700
COMMERCIAL FOREST									
Minnesota	17,000	2,820	2,120	600	100	3,300	3,800	4,270	2,810
Wisconsin	15,200	1,760	1,280	377	103	410	2,320	5,510	5,200
Michigan	17,800	2,200	2,100	23	77	3,890	80	3,500	8,130
Region total	50,000	6,780	5,500	1,000	280	7,600	6,200	13,280	16,140
NONCOMMERCIAL FOREST									
Minnesota	2,100	550	175	240	135	630	450	330	140
Wisconsin	600	290	132	73	85	43	127	90	50
Michigan	700	130	83	2	45	227	—	200	143
Region total	3,400	970	390	315	265	900	577	620	333
RESERVED FOREST									
Minnesota	600	330	270	20	40	170	50		50
Wisconsin	200	50	10		40	27	73		50
Michigan	500	170	30		140	203			127
Region total	1,300	550	310	20	220	400	123		227

to raise timber and livestock on the same land. Public agencies are interested in forests not only as a source of timber products, but also as a place for hunting, fishing, and other forms of recreation, as well as for water and soil conservation. These differences give rise to rather wide differences in methods of forest management.

NATIONAL FORESTS

Eight national forests have a gross area of 12.2 million acres, of which only a little more than half is Government owned. The intermingled land is owned by States, counties, and various companies, individuals, and a few farmers.

The United States Forest Service manages the national forests on the principle of multiple-use and sustained timber yields. It devotes most area to timber growing, but makes provision for maintaining wildlife and giving the public access to bathing beaches, canoe routes, camp sites, scenic trails, and so forth. It permits harvesting of mature timber, but regulates the method and rate of cutting to insure continuous and increasing timber production.

INDIAN FORESTS

The Office of Indian Affairs supervises about 1⅓ million acres of forest and other wild land which it holds in trust for Indian tribes and individuals. It is responsible for managing one million acres of commercial forest land in two large reservations and a number of smaller tracts.

On the Menominee Reservation in Wisconsin, it has an excellent tract of northern hardwoods, hemlock, and pine, about 200,000 acres in extent. It has been managing this fairly intensively since 1908 (*40*).

On the Red Lake Indian Forest in Minnesota it has a compact unit of 250,000 acres, primarily cut-

TABLE 9.—*Area of commercial forest land in the Lake States region, by ownership and stand class*

State	All owners	Federally owned or controlled				State	County or municipal	Private	
		Total	National forest	Indian	Other			Farm	Other
	Thousand acres	*Thousand acres*	*Thousand acres*	*Thousand acres*	*Thousand acres*	*Thousand acres*	*Thousand acres*	*Thousand acres*	*Thousand acres*
ALL STAND CLASSES									
Minnesota	17,000	2,820	2,120	600	100	3,300	3,800	4,270	2,810
Wisconsin	15,200	1,760	1,280	377	103	410	2,320	5,510	5,200
Michigan	17,800	2,200	2,100	23	77	3,890	80	3,500	8,130
Region total	50,000	6,780	5,500	1,000	280	7,600	6,200	13,280	16,140
SAW TIMBER									
Minnesota	1,600	250	170	75	5	350	200	400	400
Wisconsin	1,800	180	30	142	8	30	90	750	750
Michigan	2,500	70	60	3	7	220	10	450	1,750
Region total	5,900	500	260	220	20	600	300	1,600	2,900
POLE TIMBER									
Minnesota	2,900	820	650	150	20	680	300	600	500
Wisconsin	2,900	180	90	65	25	70	400	1,100	1,150
Michigan	3,800	320	300	5	15	910	20	800	1,750
Region total	9,600	1,320	1,040	220	60	1,660	720	2,500	3,400
SEEDLING AND SAPLING									
Minnesota	7,400	1,390	1,100	250	40	1,410	1,600	2,000	1,000
Wisconsin	6,900	1,010	890	70	50	180	1,170	2,340	2,200
Michigan	7,700	1,550	1,510	10	30	1,810	30	1,410	2,900
Region total	22,000	3,950	3,500	330	120	3,400	2,800	5,750	6,100
POORLY STOCKED AND DEFORESTED									
Minnesota	5,100	360	200	125	35	860	1,700	1,270	910
Wisconsin	3,600	390	270	100	20	130	660	1,320	1,100
Michigan	3,800	260	230	5	25	950	20	840	1,730
Region total	12,500	1,010	700	230	80	1,940	2,380	3,430	3,740

over coniferous forest land, which it has been operating under a special 1916 law "in accordance with the principles of scientific forestry with the view to production of successive crops thereon" (*16*).

Sustained-yield management on other reservations dates largely from the Indian Reorganization Act of June 18, 1934, (43 Stat. 984). Since that date the Indian forest holdings have been maintained intact and in some cases have been increased substantially. Except where long-term cutting contracts or the desires of the Indian landowners have prevented, the management has followed approved methods of cutting and provisions for new growth.

OTHER FEDERAL LANDS

In addition to the U. S. Forest Service and Office of Indian Affairs, several Federal agencies administer significant acreages of forest lands in the region.

The Fish and Wildlife Service controls some 330,000 acres of marsh with intermingled woodland, of which a part is commercial timberland. The resident managers give attention to the timber crop and follow good forestry practices when these do not conflict with the major objective of protection and propagation of game birds. In addition, the Fish and Wildlife Service has leased 81,049 acres in the Red Lake Game Preserve Area in Minnesota on a

50-year contract to the Minnesota Department of Conservation, and 58,098 acres in central Wisconsin to the Wisconsin Department of Conservation.

The National Park Service controls Isle Royale, a 134,000-acre forested tract of outstanding scenic beauty and scientific interest.

The War Department held in 1945 nearly 400,000 acres of land in the Lake States, including lands along the Mississippi needed for navigation and flood-control purposes, sites for camps and airports, and areas acquired for munition plants. Since then it has disposed of some areas. These military lands include some bottom-land hardwoods and rather extensive areas of sparse jack pine and scrub oak. Only a small part can be considered commercial timberland in their present condition and manner of use.

The Bureau of Land Management retains approximately 115,000 acres of unappropriated public domain, very little of which now supports or is capable of producing timber of commercial quality.

The Farmers' Home Administration and Soil Conservation Service also retain a few thousand acres of forest land in this region.

STATE FOREST LANDS

The States have about 8.9 million acres of forest land, including 7.6 million acres classified as commercial forest.

In Minnesota, the Department of Conservation, according to its biennial reports, has responsibility for managing approximately 5.5 million acres, of which 4.1 million are more or less forested. The Department provides fire protection for all State, county, and privately owned lands outside Federal projects. It permits regulated timber cutting on all State lands, but is primarily concerned with timber management on the 2.0 million acres of State forests. It is making a careful inventory of its property, with the aim of adding new management units and consolidating its holdings by means of exchanges with other landowners.

In Wisconsin, two agencies have jurisdiction over nearly one-half million acres of State land, including some of nonforest character. The State Land Commission controls the "trust fund" lands, amounting in 1949 to 151,500 acres. The Department of Conservation manages the State forests (260,000 acres), State parks (15,500 acres), and deer yards and public hunting grounds (32,000 acres).

In Michigan, the Department of Conservation, according to its biennial reports, controls about 4.3 million acres of land, mostly forest. It has dedicated 2.0 million as State forests, more than 1.5 million acres as game projects, and 0.1 million acres as State parks. The remainder it considers too scattered and poorly located for organized management or, in some cases, suitable for sale to private owners for agriculture, recreation, or other use. The Department provides over-all protection from fire, and supervises timber sales, planting, and various special uses (*13*). Also, it has a very active program of game management and may alter its cutting and planting programs in the interest of game propagation. It has tried controlled burning to maintain certain areas for sharp-tailed grouse (*29*).

COUNTY AND MUNICIPAL FORESTS

In Minnesota, counties have primary responsibility for managing about 4.3 million acres of tax-forfeited forest land (although legal title rests with the State and the Commissioner of Conservation has some control over local action). Until recently, the county boards have done little in forest management other than to sell timber and land as opportunities arose. Now a number of them are taking stock of their holdings, setting aside concentrated blocks as memorial forests, and making plans for permanent management.

In Wisconsin, counties hold title to about 2.5 million acres of tax-forfeited forest land, mostly cut-over (*44*). Twenty-eight counties have established county forests totaling nearly 2 million acres. They have entered these under the Wisconsin Forest Crop Law, which entitles them to receive limited financial aid from the State for county forest management. They also receive technical assistance from the district foresters of the Conservation Department. With this help, they have been making timber sales with appropriate cutting limitations, and have been planting and carrying out other improvement programs on a moderate scale.

In Michigan, tax-forfeited land reverts directly to the State and thus there has been less occasion for development of county forests than in the other Lake States. Only one county, Gogebic, has attempted to develop a forest program of any size. It has title to approximately 25,000 acres, 18,000 of which were deeded it by the State. Other counties have roadside strips and forest parks of smaller size.

In each of the States, a number of school districts, villages, towns, and cities have established memorial or other community forests of one kind or another. In Wisconsin, 200 districts have designated school forests aggregating 14,000 acres. The city of Merrill, the town of Washington in Vilas County, the county of Juneau, together with 22 other local units of government, have created community forests, having a total area of 23,000 acres. In Michigan, local units have acquired sufficient land by gift or purchase to create forests aggregating about 50,000 acres. Minnesota communities have followed a similar course.

FARM WOODS [2]

Farmers own one-fourth of all forest land in the Lake States. In spite of the large demand for wood in the farming districts, and in spite of a recognized need for trees for soil protection, game conservation *(34)*, and windbreaks *(38)*, relatively few farmers are purposefully extending or improving their woodlands *(48)*. Especially in the dairy belt, they look upon woodlands as auxiliary pasture.

In Minnesota, farm woods differ greatly in separate districts. In the western prairie belt, the woodlands cover only about 5 percent of the total farm land and consist mainly of narrow strips of bottom-land hardwoods along streams, open groves of scrubby aspen or oak on certain uplands, and numerous (and mostly decadent) shelter belts of cottonwood, green ash, and boxelder. Southeast, the farm woods are remnants of former solid forests of oak, maple, basswood, and elm, and occupy nearly 20 percent of the average farm. They remain primarily on steep or poorly drained lands, and as a rule show the effects of improper cutting, pasturing, and occasional burning. Farther north, woodlands make up nearly half of the typical farm which, in most cases, was taken up after loggers had removed the virgin timber. Present woods embrace all types, but are mainly young aspen.

In Wisconsin, likewise, the farm woodlands differ considerably by districts. Southwest, oak, maple, and elm woods cover about 30 percent of the farm land and protect the rolling unglaciated soil from water erosion. In the central sandy area, woods of jack pine and scrub oak cover about one-third of the farm land. In the intensively farmed and heavily industrialized southeast, woods remain on only a little more than 10 percent of the land. In the north, nearly half of the farm land is still wooded with aspen, young hardwoods, and various swamp forests.

In Michigan, a similar pattern exists. In the heavily industrialized southern half of the Lower Peninsula, only about 10 percent of the farm land is in woods, but these woods include some stands of maple, beech, and elm of high potential value. In the north half of the Lower Peninsula, about one-third of the farm land is forested with aspen, jack pine, scrub oak, young maple, and some swamp timber. In the Upper Peninsula, nearly half the farm acreage is wooded.

OTHER PRIVATELY OWNED FOREST LANDS

Private owners, other than farmers, control about 16.7 million acres of commercial forest land in the region. In the aggregate, these owners have a somewhat larger than average proportion of land bearing saw timber and pole timber.

Thirty-four owners of large holdings (50,000 acres or more each) control one-fifth of the total or about 3.2 million acres. Ninety-one owners of medium-sized holdings (5,000 to 49,999 acres each) control about 1.3 million acres. Owners of small holdings control the remaining 12.2 million acres (fig. 21).

Of the owners of large and medium-sized holdings, 50 are lumber companies; 20 are pulp companies. The rest include companies engaged in mining, railroading, power development, agricultural development, as well as hunting clubs, estates, and some land speculators. The lumber company and the pulp company groups each control about 1.6 million acres (fig. 22). Holdings of the former are declining, while those of the pulp companies have increased more than 33 percent during the past 5 years *(1, 5, 41)*.

Private timberland owners cite high and uncertain property taxes as a major obstacle to sustained-yield forest management. Merchantable timber, although usually appraised considerably below its market value, nevertheless is taxed each year at rates which may deter many owners from holding timber for continuous selective logging.

---

[2] The acreage of forest land in farms as determined by the Forest Survey was somewhat larger than the "woodland in farms" reported in the 1945 Census of Agriculture. This report has used the census figure (rounded off) as equivalent to the commercial forest area, assuming that some additional noncommercial forest (brush and lightly wooded land) is included in the census classification of "other land."

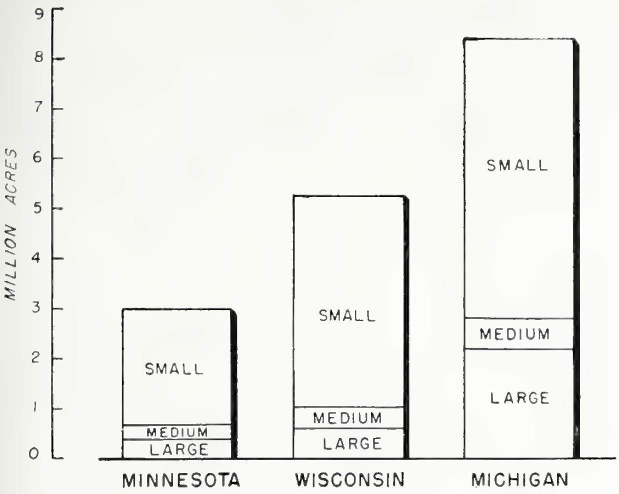


FIGURE 21.—*Acreage of commercial forest controlled by private (nonfarm) owners of large, medium-sized, and small holdings in each State.*

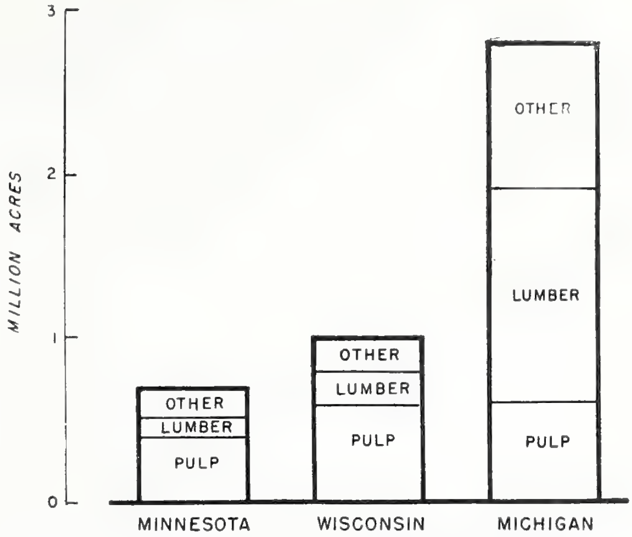


FIGURE 22.—*Acreage of large and medium-sized private holdings owned by different industry groups in each State.*

Cut-over land commonly is taxed at approximately the same rate as adjoining improved farm land.

Each State in the region has a special forest tax law under which landowners can apply for a special classification enabling them to pay a small annual tax (varying among states from 5 to 10 cents per acre) plus a 10-percent yield tax at time of cutting. Only small acreages of private land are registered under these laws for various reasons, including local opposition to foregoing immediate tax yields.

Volumes

The total volume of live timber on commercial forest land in the Lake States is 27 billion cubic feet. This is an average of 540 cubic feet (about 7 cords) per acre. It consists of 20 billion cubic feet of primary growing stock from which most of the present and future merchantable timber products must be obtained, and 7 billion cubic feet of secondary material in the form of limbs of large hardwood trees, and cull trees (table 10).

TABLE 10.—*Volume*[1] *of live timber on commercial forest land in the Lake States region, 1950*

State	Total volume	Primary growing stock [2]				Secondary growing stock	
		Total	Saw timber [3]	Cordwood [4]			
				Softwood tops	Pole timber	Hardwood limbs	Cull [5] trees
	Million cubic feet	*Million cubic feet*	*Million cubic feet*	*Million cubic feet*	*Million cubic feet*	*Million cubic feet*	*Million cubic feet*
Minnesota	7,500	5,700	1,360	200	4,140	500	1,300
Wisconsin	8,500	6,100	2,000	125	3,975	1,100	1,300
Michigan	11,000	8,200	3,040	275	4,885	1,600	1,200
Region total	27,000	20,000	6,400	600	13,000	3,200	3,800

---

[1] Cubic-foot volume of saw-timber, pole-timber, and cull trees of all species from stump to a minimum 4-inch top inside bark. Includes bole only of softwood (no limb wood), but both bole (central stem) and limbs of hardwoods to a minimum 4-inch diameter inside bark.

[2] Volume of live saw- and pole-timber trees from stump to a minimum 4-inch top (of central stem) inside bark. Excludes cull trees and that part of hardwood saw-timber trees above where the bole breaks into limbs. *Secondary growing stock:* all timber excluded from primary growing stock.

[3] In board feet: Minnesota, 8,500,000; Wisconsin, 12,500,000; Michigan, 19,000,000; region total, 40,000,000. By International (¼-inch kerf) log scale which closely approximates green-chain tally. This volume was estimated for all softwood trees 9 inches d.b.h. or more and hardwood trees 11 inches d.b.h. or more that had at least one 8-foot log of usable quality. Minimum top diameter for sawlogs was 8 inches inside bark. Deductions were made for rot, crook, fork, shake, and other defects.

[4] Cords are on the basis of 75 cubic feet of wood per cord, which, for the average size and shape of cordwood, will make a stack of standard size 4 by 4 by 8 feet when piled with bark on.

[5] Large trees (18 inches d.b.h. or more) which did not contain one 16-foot No. 1 or No. 2 grade log, or two 16-foot No. 3 grade logs. Smaller sawlog-size trees (10 to 16 inches d.b.h.) that did not contain one 8-foot No. 1 or 2 log, or one 16-foot No. 3 log. Pole-timber trees that apparently would never produce marketable products other than fuel wood. Cedar trees too crooked or decayed to produce at least one 16-foot pole or two 7-foot posts.

Primary Growing Stock

The primary growing stock is that part of the stand which either has significant merchantable value for products other than fuel wood or has prospects of growing into material of value in the future. It consists of the net volume of live saw-timber trees and live pole-timber trees from stump to a minimum 4-inch top, but excludes all limb wood.

Roughly one-third of the primary growing stock is in the form of saw timber, two-thirds in the form of cordwood below sawlog size. Most of the cordwood is in pole timber, that is, in trees ranging in diameter breast high from 5.0 to 8.9 inches in the case of softwood species or 5.0 to 10.9 inches in the case of hardwoods. A small part of the cordwood consists of the tops of softwood saw-timber trees.

Most of the sawlog volume is in saw-timber stands but the larger share of cubic-foot volume is in stands below saw-timber size (table 11).

SAW TIMBER

The present volume of saw timber—40 billion board feet—is only about 5 percent of the original volume in the region (*26*). It is only one-third of that reported in 1918 (*37*), and somewhat less than reported in 1936 and 1945 (*39*). Not too much significance should be placed on relatively minor changes in recent years, however, because they have been affected by the standards of measure by which the timber has been estimated.[3] The important point is that the original timber stand has been largely liquidated and the present volume of second growth is only about half that required to sustain a high and steady yield of saw-timber products.

TABLE 11.—*Volume of primary growing stock on commercial forest land in the Lake States region, by stand class, 1950*

Stand class	Live saw timber		All primary growing stock	
	Total volume	Average per acre	Total volume	Average per acre
	Million board feet	*Board feet*	*Million cubic feet*	*Cubic feet*
Saw timber	31,400	5,320	8,950	1,520
Pole timber	5,550	580	6,700	700
Seedlings and saplings	2,150	100	3,500	160
Poorly stocked and deforested	900	70	850	70
Total	40,000	800	20,000	400

Average quality of the hardwood saw timber is rather poor. In 1936, about 30 percent of the total hardwood volume was in No. 3 logs, the minimum acceptable for railroad ties and rough lumber. With current Survey standards, the proportion is even larger.

Michigan has the largest share of remaining saw timber, Minnesota the least (table 12). Hardwoods, predominantly sugar maple, oak, aspen, and elm make up 70 percent of the total volume. Hemlock, white pine, and jack pine are the predominant softwood species.

TABLE 12.—*Board-foot volume of saw timber on commercial forest land in the Lake States region, by species, 1950*

Species	Region total	Minnesota	Wisconsin	Michigan
	Million board feet	*Million board feet*	*Million board feet*	*Million board feet*
Softwoods:				
White pine	2,400	1,000	700	700
Red pine	900	400	200	300
Jack pine	2,000	1,400	300	300
Hemlock	3,900	0	900	3,000
Spruce	1,300	700	100	500
Balsam fir	1,300	400	300	600
Tamarack	200	100	—	100
Total	12,000	4,000	2,500	5,500
Hardwoods:				
Sugar maple	7,900	300	2,500	5,100
Yellow birch	2,000	100	500	1,400
Basswood	1,900	500	500	900
Beech	1,100	0	100	1,000
Elm	3,000	700	1,200	1,100
Oak[1]	5,300	700	3,200	1,400
Aspen	3,200	1,400	800	1,000
Miscellaneous	3,600	800	1,200	1,600
Total	28,000	4,500	10,000	13,500
All species	40,000	8,500	12,500	19,000

[1] Approximately two-thirds of all oak is red oak.

---

[3] Original timber estimates, as well as those of 1918, were in terms of Scribner decimal C scale and overlooked considerable volume of timber other than white and red pine. From 1936 on, estimates were by International ¼-inch rule, which is roughly 15 percent higher than Scribner decimal C. Between 1936 and 1950, certain changes were made in specifications for saw timber in the interest of standardizing estimates for the eastern United States. One change—excluding hardwood trees in the 10-inch diameter class from the saw-timber estimate and raising the minimum diameter for aspen logs from 6 to 8 inches—was largely responsible for the 20-percent reduction in saw-timber estimates between 1945 and 1950. On the other hand, a loosening of specifications for low-grade hardwood logs (to reflect the trend toward closer utilization) has the effect of increasing the estimate of saw-timber volume in the southern forest zone, which has a preponderance of farm woods.

CORDWOOD VOLUME

The volume of primary growing stock below sawlog size amounts to about 180 million cords (13.6 billion cubic feet). Seventy percent of the cordwood is of hardwood species; only 30 percent is softwood (table 13).

The current estimate of cordwood volume is about 20 percent greater than reported in 1945, mainly because the volume in hardwood trees in the 10-inch diameter class previously classified as saw timber has been included with cordwood here.

From a utility standpoint, cordwood can be divided into two main classes: (1) Pulpwood, including all of the jack pine, spruce, balsam fir, hemlock, and about 42 percent of the aspen, and (2) other cordwood, including all other species and that portion of the aspen considered too poor in quality to make pulpwood according to present standards.

One-third of all cordwood, or 60 million cords comes under the pulpwood classification (fig. 23).

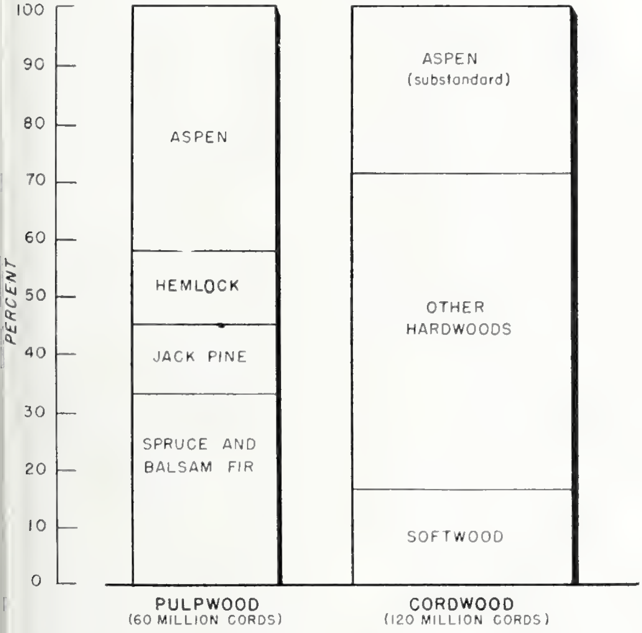


FIGURE 23.—*Species composition of cordwood volume suitable for pulpwood and other cordwood.*

Some of the cordwood of species not commonly pulped is currently usable for industrial purposes and for fuel. A great deal of it, especially in hardwoods in pole stands, should be considered growing stock for production of future saw timber.

TOTAL CUBIC-FOOT VOLUME

The total primary growing stock volume, that is the combined volume of saw-timber and pole-timber trees converted to cubic feet, is somewhat more evenly divided between States than the saw timber alone (table 14). Hardwoods comprise 70 percent of the total volume, with aspen, maple, and oak predominating.

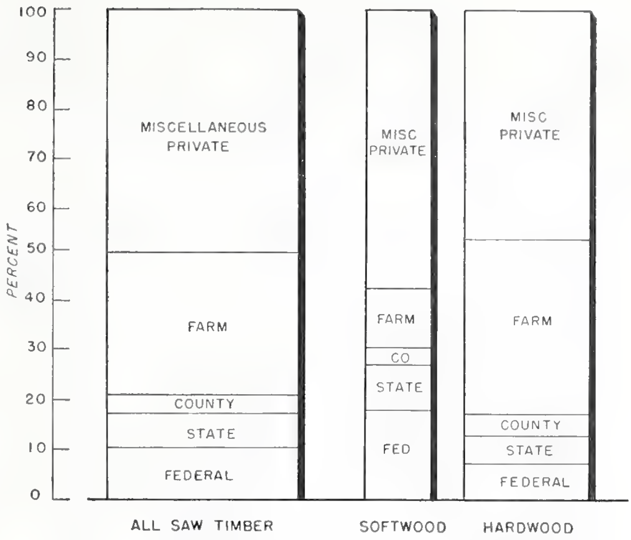


FIGURE 24.—*Volume of saw timber by ownership groups.*

OWNERSHIP

Private landowners, including farmers, control approximately four-fifths of the saw timber and half of the cordwood suitable for pulpwood. In saw timber, the private ownership is most notable in hardwood species, where it accounts for 83 percent of the total (table 15, fig. 24).

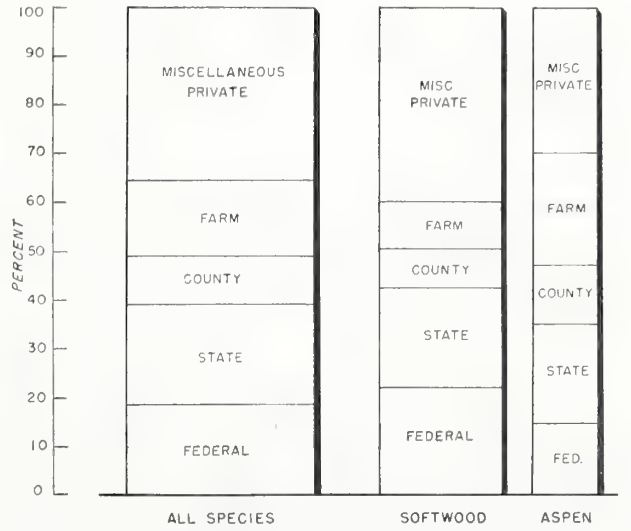


FIGURE 25.—*Volume of cordwood suitable for pulpwood by ownership groups.*

TABLE 13.—*Cordwood volume on commercial forest land in the Lake States region, by species, 1950*

Species	Region total	Minnesota	Wisconsin	Michigan
	Thousand cords	*Thousand cords*	*Thousand cords*	*Thousand cords*
Softwoods:				
White pine	4,000	1,300	1,400	1,300
Red pine	2,700	1,000	900	800
Jack pine	7,000	3,500	1,600	1,900
Hemlock	7,700	0	2,100	5,600
Spruce	9,100	5,400	800	2,900
Balsam fir	10,600	4,200	2,100	4,300
Tamarack	4,900	2,400	800	1,700
Cedar	8,000	2,600	1,300	4,100
Total	54,000	20,400	11,000	22,600
Hardwoods:				
Sugar maple	21,700	2,900	8,000	10,800
Yellow birch	2,300	200	800	1,300
Basswood	5,300	1,600	1,600	2,100
Beech	1,700	0	600	1,100
Elm	5,500	1,100	2,200	2,200
Oak	12,300	2,400	6,400	3,500
Aspen	61,000	23,500	18,100	19,400
Miscellaneous	16,200	4,900	5,300	6,000
Total	126,000	36,600	43,000	46,400
All species	180,000	57,000	54,000	69,000

TABLE 14.—*Cubic-foot volume of primary growing stock on commercial forest land in the Lake States region, by species, 1950*

Species	Region total	Minnesota	Wisconsin	Michigan
	Million cubic feet	*Million cubic feet*	*Million cubic feet*	*Million cubic feet*
Softwood:				
White pine	700	270	220	210
Red pine	350	140	100	110
Jack pine	850	490	170	190
Hemlock	1,200	0	300	900
Spruce	900	520	80	300
Balsam fir	1,000	380	200	420
Tamarack	400	200	60	140
Cedar	600	200	100	300
Total	6,000	2,200	1,230	2,570
Hardwood:				
Sugar maple	2,900	270	1,000	1,630
Yellow birch	500	30	150	320
Basswood	700	200	200	300
Beech	300	0	60	240
Elm	900	200	360	340
Oak	1,800	300	1,000	500
Aspen	5,200	2,000	1,500	1,700
Miscellaneous	1,700	500	600	600
Total	14,000	3,500	4,870	5,630
All species	20,000	5,700	6,100	8,200

TABLE 15.—*Board-foot volume of saw timber on commercial forest land in the Lake States region, by ownership class and species group*

State	All owners	Federally owned or controlled				State owned or controlled	County or municipal	Private	
		Total	National forest	Indian	Other			Farm	Other
	Million board feet	*Million board feet*	*Million board feet*	*Million board feet*	*Million board feet*	*Million board feet*	*Million board feet*	*Million board feet*	*Million board feet*
ALL SPECIES									
Minnesota	8,500	2,300	2,000	280	20	1,300	900	2,300	1,700
Wisconsin	12,500	1,070	300	750	20	350	630	5,150	5,300
Michigan	19,000	730	700	10	20	1,100	20	3,950	13,200
Region total	40,000	4,100	3,000	1,040	60	2,750	1,550	11,400	20,200
SOFTWOODS									
Minnesota	4,000	1,425	1,280	140	5	720	325	630	900
Wisconsin	2,500	545	60	480	5	100	65	470	1,320
Michigan	5,500	170	160	5	5	280	10	400	4,640
Region total	12,000	2,140	1,500	625	15	1,100	400	1,500	6,860
HARDWOODS									
Minnesota	4,500	875	720	140	15	580	575	1,670	800
Wisconsin	10,000	525	240	270	15	250	565	4,680	3,980
Michigan	13,500	560	540	5	15	820	10	3,550	8,560
Region total	28,000	1,960	1,500	415	45	1,650	1,150	9,900	13,340

Cordwood suitable for pulpwood is about equally divided between public and private owners. Public agencies control 57 percent of the spruce and balsam fir, and 64 percent of the jack pine, but they have only 46 percent of the good aspen, and only 18 percent of the hemlock (table 16, fig. 25).

Of the total cubic-foot volume of primary growing stock, private owners control 66 percent. Here again it is mostly in hardwoods (table 17).

Secondary Material

In addition to the primary growing stock, the region has approximately 95,000,000 cords of sound wood in cull trees and limbs of hardwood saw-timber trees. Material of this kind is suitable for fuel, chemical wood, fence posts, and certain other products, but under present market conditions it is not considered to have a great deal of merchantable value.

TABLE 16.—*Pulpwood volume*[1] *on commercial forest land in the Lake States region, by ownership class and major pulp species*

State	All owners	Federally owned or controlled				State owned or controlled	County or municipal	Private	
		Total	National forest	Indian	Other			Farm	Other
	Thousand cords	*Thousand cords*	*Thousand cords*	*Thousand cords*	*Thousand cords*	*Thousand cords*	*Thousand cords*	*Thousand cords*	*Thousand cords*
ALL PULP SPECIES									
Minnesota	23, 500	6, 900	5, 600	1, 270	30	6, 300	4, 100	2, 600	3, 600
Wisconsin	13, 800	2, 050	1, 200	810	40	400	1, 650	3, 500	6, 200
Michigan	22, 700	2, 050	2, 000	20	30	5, 600	50	3, 300	11, 700
Region total	60, 000	11, 000	8, 800	2, 100	100	12, 300	5, 800	9, 400	21, 500
SPRUCE AND BALSAM FIR									
Minnesota	9, 600	2, 170	1, 600	560	10	3, 500	1, 630	800	1, 500
Wisconsin	2, 900	910	600	300	10	50	340	600	1, 000
Michigan	7, 200	620	600	10	10	2, 050	30	800	3, 700
Region total	19, 700	3, 700	2, 800	870	30	5, 600	2, 000	2, 200	6, 200
JACK PINE									
Minnesota	3, 500	2, 300	2, 000	290	10	400	270	230	300
Wisconsin	1, 600	190	50	130	10	50	310	250	800
Michigan	1, 900	560	550	(2)	10	400	20	220	700
Region total	7, 000	3, 050	2, 600	420	30	850	600	700	1, 800
HEMLOCK									
Wisconsin	2, 100	400	150	250	(2)	100	200	200	1, 200
Michigan	5, 600	250	250	(2)	(2)	450	(2)	300	4, 600
Region total	7, 700	650	400	250	(2)	550	200	500	5, 800
ASPEN[3]									
Minnesota	10, 400	2, 430	2, 000	420	10	2, 400	2, 200	1, 570	1, 800
Wisconsin	7, 200	550	400	130	20	200	800	2, 450	3, 200
Michigan	8, 000	620	600	10	10	2, 700	(2)	1, 980	2, 700
Region total	25, 600	3, 600	3, 000	560	40	5, 300	3, 000	6, 000	7, 700

---

[1] This volume is in addition to the saw-timber volume shown in table 15.

[2] Less than 500 cords.

[3] Includes only material sufficiently straight, sound, and large enough to make standard pulpwood.

TABLE 17.—*Cubic-foot volume of primary growing stock on commercial forest land in the Lake States region, by ownership class and species group*

State	All owners	Federally owned or controlled				State owned or controlled	County or municipal	Private	
		Total	National forest	Indian	Other			Farm	Other
	Million cubic feet	*Million cubic feet*	*Million cubic feet*	*Million cubic feet*	*Million cubic feet*	*Million cubic feet*	*Million cubic feet*	*Million cubic feet*	*Million cubic feet*
ALL SPECIES									
Minnesota	5,700	1,420	1,200	210	10	1,250	800	1,230	1,000
Wisconsin	6,100	710	390	300	20	190	500	2,300	2,400
Michigan	8,200	770	740	10	20	1,110	20	1,900	4,400
Region total	20,000	2,900	2,330	520	50	2,550	1,320	5,430	7,800
SOFTWOODS									
Minnesota	2,200	670	550	117	3	650	225	185	470
Wisconsin	1,230	260	90	167	3	50	95	300	525
Michigan	2,570	270	260	6	4	350	10	375	1,565
Region total	6,000	1,200	900	290	10	1,050	330	860	2,560
HARDWOODS									
Minnesota	3,500	750	650	93	7	600	575	1,045	530
Wisconsin	4,870	450	300	133	17	140	405	2,000	1,875
Michigan	5,630	500	480	4	16	760	10	1,525	2,835
Region total	14,000	1,700	1,430	230	40	1,500	990	4,570	5,240

Growth and Mortality

ONE of the most significant figures in the appraisal of the forest situation is the rate of current timber growth. This figure reflects the net effect of stocking, stand condition and thriftiness of the growing stock. Contrasted with drain it is an indicator of probable trend in inventory volumes.

Current Annual Net Growth

Approximately 720 million cubic feet of new volume, including 1,200 million board feet of saw-timber material, are added to the timber stands in the Lake States region each year (table 18).

The average growth per acre in cubic feet in the Lake States is one-third less than in the Pacific Northwest, and only about half that reported in the South. It is considerably less also than in the New England and Central States regions (*39*).

The average growth per acre of saw timber in this region is only one-third as large as in the Pacific Northwest, one-fourth as large as in the South.

TABLE 18.—*Estimated net annual growth in the Lake States region, by stand class, 1950*

Stand class	All timber			Saw timber		
	All species	Soft-wood	Hard-wood	All species	Soft-wood	Hard-wood
	Million cubic feet	*Million cubic feet*	*Million cubic feet*	*Million cubic feet*	*Million cubic feet*	*Million cubic feet*
Old-growth saw timber	30	10	20	100	30	70
Second-growth saw timber	80	20	60	320	80	240
Pole timber	280	65	215	570	160	410
Seedlings and saplings, and poorly stocked and deforested	330	85	245	210	90	120
Total	720	180	540	1,200	360	840

The relatively short growing season, and the extent of low site swampland place the Lake States at a comparative disadvantage with some of the other regions but do not fully account for the differences in annual growth. The low rate in this region is primarily a result of heavy mortality, and the excessively large proportion of acreage in deforested or newly restocked condition.

Because in most parts of the region the timber is so young, more than half of the annual growth consists of so-called "ingrowth," that is, volume credited to trees which have just reached minimum merchantable size. In Clearwater County, Minn., for example, the survey made in 1949 showed that 63 percent of the current annual growth was newly recognized volume of trees which had just entered the 6-inch diameter class. In the case of saw timber, 67 percent was volume credited to trees which had just attained minimum saw-timber size. The trees involved may be 30 years or more of age when they first attain pole-timber size. Thus ingrowth credits to the current year new volume which actually has accrued over a longer period. Obviously, not all of this kind of growth is ready for immediate conversion into timber products.

Mortality

Roughly 700 million cubic feet of timber, including 1,000 million board feet of saw-timber size succumbs to suppression, fire, or natural enemies in a typical year (table 19).

Suppression and Deterioration

As trees grow in size, they compete more and more with each other for food, light, and water. Many are suppressed and killed in the process. For example, a fairly well-stocked 20-year-old jack pine stand loses half of its trees through suppression before it reaches 30-year age and half of the remainder before it reaches 50-year age. Many of these dying trees would be usable for pulpwood, posts, and fuel wood if salvaged at the right time.

In old stands, especially those degraded by previous high grading logging operations, the losses from dying trees and from the advance of rot, cracks, and other cull agents, frequently equal or exceed net growth. On some previously cut-over areas, now classified as restocking or pole-timber areas, enough cull trees, and large spreading wolf trees of poor quality have been left to interfere appreciably with the normal development of the young timber on the land.

TABLE 19.—*Estimated annual mortality in the Lake States region, from suppression, fire, and natural enemies, by stand class*

Stand class	All timber			Saw timber		
	All species	Softwood	Hardwood	All species	Softwood	Hardwood
	Million cubic feet	*Million cubic feet*	*Million cubic feet*	*Million cubic feet*	*Million cubic feet*	*Million cubic feet*
Large saw timber	60	10	50	150	30	120
Small saw timber	150	35	115	350	100	250
Pole timber	290	60	230	400	200	200
Seedlings and saplings, and poorly stocked and deforested	200	55	145	100	20	80
Total	700	160	540	1,000	350	650

Forest Fires

Fires, although much less destructive than a few decades ago, still are a factor in retarding current growth.

From 1870 to 1930, the region had a tragic record including loss of many billions of feet of standing timber and more than 2,800 human lives. Shocked by these losses, and stimulated by Federal aid under the Weeks Law of 1911, and the Clarke-McNary Law of 1924, the three States established protective systems which have developed to be among the best in the country. During the 10-year period, 1938-47, the acreage burned annually was held to an average of 94,232 acres or less than two-tenths of 1 percent of the area protected. During 1948, a somewhat worse than average fire year, the burned area increased to 150,000 acres.

Insects and Diseases

From the standpoint of mature timber, the region has had relatively light losses from epidemic insect or disease attack in recent years. Since the severe attacks of the larch sawfly *(Pristiphora erichsonii)* beginning about 1910, and the spruce budworm *(Archips fumiferana)* a few years later, infestations have been spotty and not too serious.

Defoliations of aspen by the forest tent caterpillar *(Malacosoma disstria)* have resulted in rather heavy losses in that species. The hemlock borer *(Melanophila fulvoguttata)*, the Saratoga spittle bug *(Aphrophora saratogensis)*, the red-headed sawfly *(Neodiprion lecontei)*, white grub *(Phyllophaga* spp.), and white pine weevil *(Pissodes strobi)* all have caused more or less damage to timber stands.

Among the tree diseases, the white pine blister rust *(Cronartium ribicola)* has caused greatest concern in this region. Blister rust control work has been performed on 75 percent of the white pine area in this region, but much of this area will need to be reworked to insure safety of the species.

Heart rot *(Fomes igniarius)* and stem canker *(Hypoxylon pruinatum)* are major obstacles to development of sawlog-size aspen (*27*). Heart rots in pine *(Fomes pini* and *Polyporus schweinitzii)* cause heavy losses when stands are allowed to remain beyond their prime. The oak wilt *(Chalara quercina)* has caused some damage in the southern part of the region.

Experts working with these natural enemies believe that losses can be reduced considerably by (1) research to develop better methods of control, (2) a detection system to spot incipient outbreaks, and (3) a control organization ready for prompt action. Much can be done also by improved forest management which will raise the general health and vigor of the stands.

Other Losses

The Lake States forests occasionally suffer severe losses from wind, sleet, drought, flooding, browsing, etc.

In 1932 a heavy wind destroyed about 300,000 cords of jack pine and other timber on the Superior National Forest. A storm in 1940 felled some 30 million feet of pine on the Chippewa National Forest. Three storms in the period 1933-36 blew down 80 million board feet of hemlock and other timber on the Menominee Indian Reservation in Wisconsin. Fortunately a considerable portion of such windblown timber has been salvaged for commercial use.

Sleet storms bring constant losses in volume and quality of timber, and occasionally mutilate extensive areas of young growth. Changes in water levels caused by beaver action, by industrial activity, and sometimes by climatic fluctuations, often seriously damage timber stands. Damage from wild game or domestic livestock is appreciable in some districts. To these can be added minor losses from sunscald, drought, frost cracking, snow breakage, etc.

Potential Current Growth

It is not practicable to eliminate mortality from a forest area of such wide extent as that in the Lake States. However, it would be feasible to reduce the losses at least 25 percent through improved forest management and better utilization.

Such management and utilization would include: (1) extending logging operations into hitherto uncut areas to salvage overmature timber now going to waste, (2) engaging in frequent partial cuttings for the purpose of salvaging recently killed timber, anticipating imminent mortality, and stimulating growth of remaining trees, (3) avoiding "high grading" operations, (4) improving protection from fires, insects, and disease, (5) reducing pasturing of farm woods, and (6) clearing out undesirable trees which hinder growth.

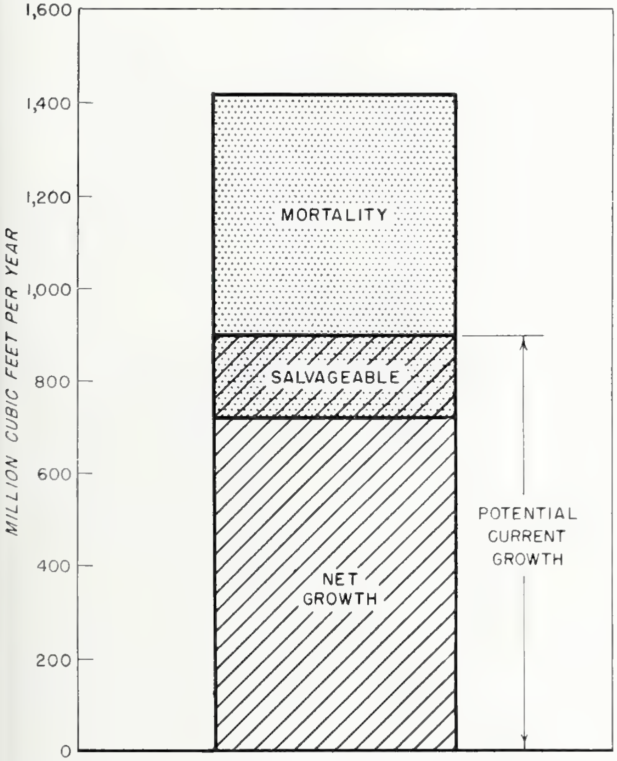


FIGURE 26.—*Potential current growth as related to actual net growth and mortality.*

By these measures, net growth could be increased almost immediately to about 900 million cubic feet instead of the present 720 million (figure 26). Growth in board feet could be 1,450 million instead of the present 1,200 million.

Potential Future Growth and Yields

Continued good cutting practices and good protection combined with efforts to establish a better distribution of stand classes, could increase growth sufficiently to provide steadily increasing yields of timber for industry and still leave a surplus to build up growing stock. A rough estimate of the possible course of future yields is shown in table 20. A comparison of total yield and total growth is given in figure 27.

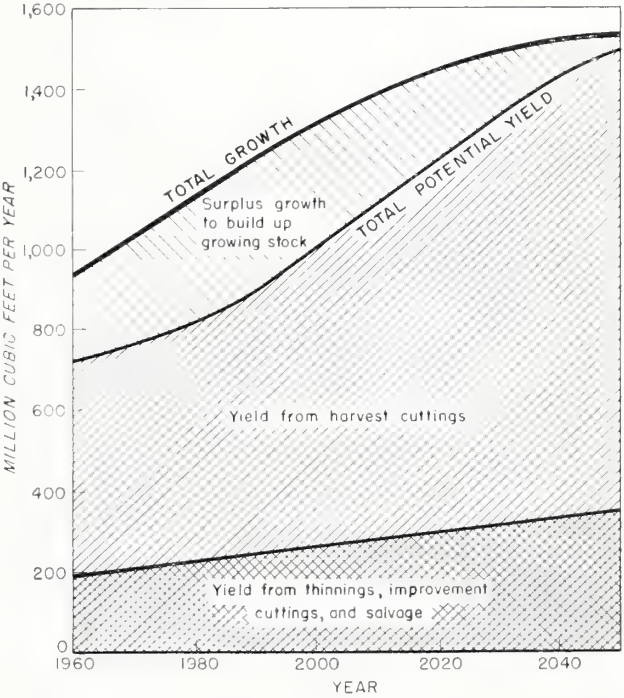


FIGURE 27.—*Potential future growth and yield from natural stands in the Lake States, 1960–2050.*

Table 20.—*Potential annual yield of existing stands and restocking areas*[1] *in the Lake States region, under good management*

Year	All timber			Saw timber			Average per acre	
	All species	Softwoods	Hardwoods	All species	Softwoods	Hardwoods		
	Million cubic feet	*Million cubic feet*	*Million cubic feet*	*Million board feet*	*Million board feet*	*Million board feet*	*Cubic feet*	*Board feet*
1960	730	190	540	1,300	400	900	15	26
1980	820	250	570	1,500	480	1,020	16	30
2000	1,000	380	620	1,920	600	1,320	20	38
2020	1,220	500	720	2,770	770	2,000	24	55
2040	1,440	580	860	3,330	1,000	2,330	29	67
2050	1,500	600	900	3,400	1,100	2,300	30	68

[1] Yields from possible future plantations not included; does not include surplus growth left to build up growing stock.

Forest Industries

NEARLY 5,800 wood-processing plants operate in the Lake States (table 21.) These employ approximately 130,000 persons for varying periods, pay direct salaries and wages of at least 100 million dollars, and turn out products worth close to three-quarters of a billion dollars annually.

Sawmills

At the peak of the industry in about 1889, Lake States sawmills produced approximately 10 billion board feet of lumber. In subsequent years lumber production steadily declined to a low of about one-half billion feet annually during the depression years of the 1930's. During the decade 1939-48 the annual cut has averaged about 1.1 billion feet. Michigan accounted for about 45 percent of the lumber cut in the Lake States during this period.

The region has more than 5,400 sawmills, and approximately 5,200 were active in 1947 (table 21). Of these, 35 were large mills, 157 were medium-sized, and 5,008 were small.

TABLE 21.—*Primary timber-processing plants and persons employed, Lake States region*

PROCESSING PLANTS

Item	Region total	Minnesota	Wisconsin	Michigan
	Number	*Number*	*Number*	*Number*
Sawmills [1]	5,200	1,525	1,776	1,899
Pulp and paper [1]	147	17	74	56
Other mills, 1946[2]	418	64	237	117
Total	5,765	1,606	2,087	2,072

PERSONS EMPLOYED

Item	Region total	Minnesota	Wisconsin	Michigan
Sawmills [1]	26,700	7,300	9,300	10,100
Pulp and paper [1]	35,400	5,500	18,000	11,900
Other mills, 1946 [2]	6,400	1,100	2,100	3,200
Woods operations [2]	61,500	14,700	20,300	26,500
Total	130,000	28,600	49,700	51,700

[1] From Census of Manufacturers: 1947. MC24A and MC26A.
[2] Lake States Forest Experiment Station estimates.

The large mills cut from 5 million to 25 million or more board feet each, the average being about 11 million feet. Typical large mills employ 50 to 100 men, including mill workers, yardmen, dry-kiln men, and shipping force. Most mills operate year-round.

The typical medium-size mill produces from 1 million to 5 million board feet per year, the average being 2 million. It has a Diesel, gas, or electric power plant to drive a circular headsaw, has a planer, edger, and cut-off saw, and employs a crew of 15 to 25 men.

The typical small mill produces less than 1 million board feet per year, the average being about 120 thousand board feet. It is operated in the open or under partial shelter, has a light to medium circular saw, and in most cases little or no secondary equipment. It has a crew of 3 to 15 men, and operates on a short seasonal schedule, usually a few weeks in spring or late fall.

Large mills are declining in number and output. Compared with 10 recorded in Minnesota in 1929, only 4 were found in 1947. Of 47 active in Wisconsin in 1929, only 11 remained in 1947, and several have shut down subsequently. Of 30 in Michigan in 1929, 20 remained in 1947. The large mills in 1947 produced only one-fourth as much lumber as those in 1929 (fig. 28). Moreover, only one-fourth of the remaining mills have control of sufficient stumpage to continue large-scale operations beyond 1960. Thus, further sharp drops in production from this group are to be expected.

Medium-sized mills have replaced some of the closed large mills, and some entirely new operations have been installed to utilize aspen and other second-growth timber. Minnesota had only 10 medium-sized mills in 1929, but had 30 in 1947. Wisconsin had 18 such mills in 1929, 57 in 1947. Michigan had 12 in 1929, 70 in 1947. Combined production

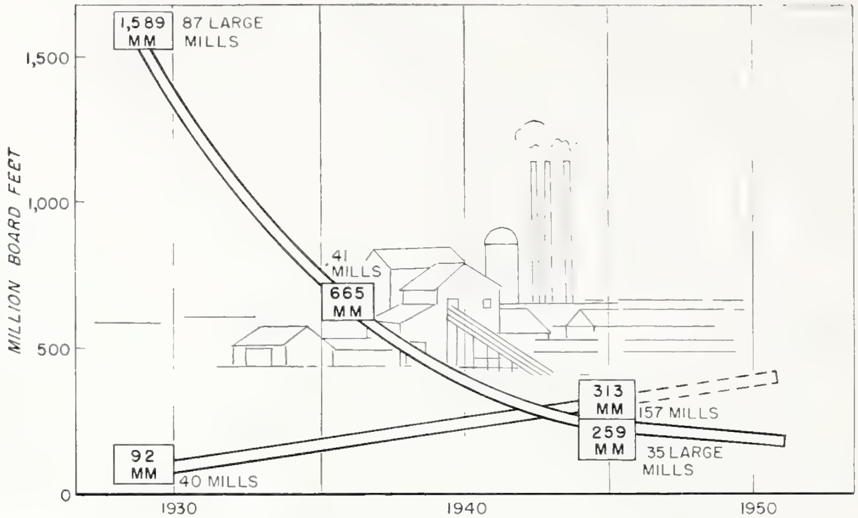


FIGURE 28.—*Trends in number and production of large and medium-sized sawmills since 1929.*

rose from 92 million board feet to 313 million board feet in this period. Since mills of this type do not require large holdings of timberland and stumpage, and commonly can operate on logs trucked in by farmers and small jobbers, they are better adapted to present conditions in the northern part of the Lake States than the large mills. Usually they are more efficient and turn out a better product than the very small mills. Logically they should continue to increase in the relatively well forested parts of the region (*8*).

The present number of very small and rather poor sawmills seems unduly large in relation to the quantity of lumber they produce and to the extent and condition of the woodlands in the southern part of the region where most of them operate. However, if the timber stands improve, and if markets can be found for more of the lower quality woods available, it is possible that the total output from small mills will continue to increase for many years. Further development of really efficient small mills, especially of the portable type, which logically should replace many of the old farmyard mills, may tend to reduce the total number in operation.

Pulp and Paper Mills

Partially offsetting the decline of the lumber industry in the Lake States has been the development of an increasingly important pulp and paper industry. Pulpwood consumed by Lake States mills has increased from less than 0.5 million cords in 1904 to 2.8 million cords in 1948. Nearly two-thirds of the pulpwood consumed in recent years has been used by pulp mills in Wisconsin.

A total of 101 paper mills and 46 pulp mills operated in the Lake States in 1947. They employed an estimated 35,300 workers exclusive of woods workers, paid approximately 112 million dollars in salaries and wages, and turned out products worth roughly 538 million dollars (table 22).

The paper mills turned out 3.8 million tons of paper and board in 1947—approximately 18 percent of the national output. In the process, they consumed 2.1 million tons of wood pulp, of which nearly one-third was imported from Canada and other foreign sources. The Lake States pulp mills themselves produced a little more than 1.5 million tons, consuming 2.6 million cords of wood (fig. 29).

The pulp and paper industry in this region enjoys a number of competitive advantages in the form of good location with reference to markets, good supply of water and power, a skilled and stable labor supply, and close contact with research agencies. Its future, however, is definitely tied to its relationship with the wood supply. If it can get enough wood at reasonable cost, it can maintain its present position or expand somewhat. If it must continue to haul wood from more and more distant points, it will probably decline.

Spruce and balsam fir accounted for 48 percent of the 2.8 million cords of pulpwood consumed in 1948. Pine made up 22 percent, aspen 22 percent, hemlock 6 percent, and other species 2 percent of

TABLE 22.- *Employment and production data for pulp and paper mills in the Lake States region, 1947*[1]

State	Pulp mills	Paper and paperboard mills	Employees (average)		Salaries and wages		Value of paper and paperboard products
			Pulp mills	Paper and paperboard mills	Pulp mills	Paper and paperboard mills	
	Number	*Number*	*Number*	*Number*	*Thousand dollars*	*Thousand dollars*	*Thousand dollars*
Minnesota	7	10	1,354	4,133	4,038	13,003	79,861
Wisconsin	29	45	4,852	13,126	14,359	39,613	240,161
Michigan	10	46	1,241	10,615	3,694	37,037	218,240
Region total	46	101	7,447	27,874	22,091	89,653	538,262

[1] From Census of Manufacturers: 1947. MC26A.

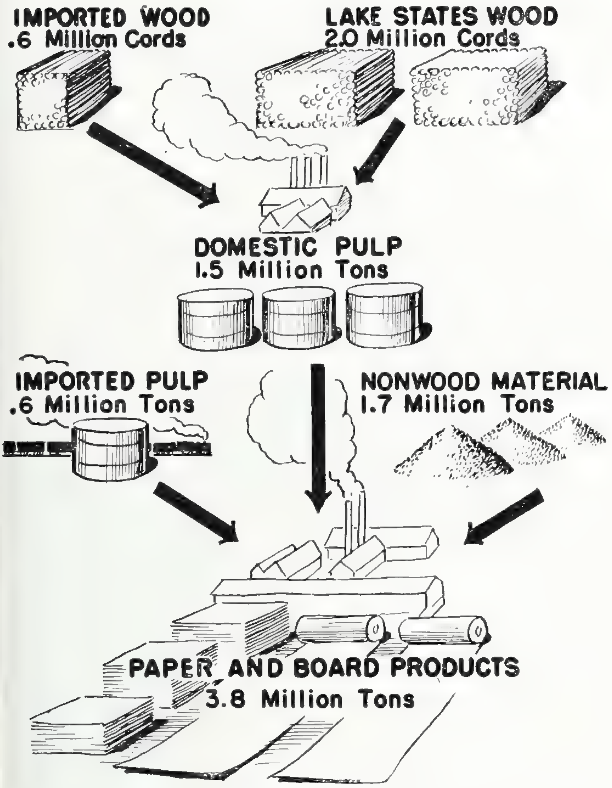


FIGURE 29.—*Source of materials entering into production of paper and paperboard in the Lake States.*

the total. About one-fourth of the total pulpwood, chiefly spruce and fir, was imported from Canada.

Currently, the pulp mills are having trouble getting the required volume of coniferous wood from nearby forest lands. Those in central Wisconsin and southern Michigan are the most seriously affected. They are meeting the difficulty temporarily by importing wood from northern Minnesota, northern Michigan, Rocky Mountain States, and Canada. However, the exporting States and provinces are disposed to restrict the export of raw wood. Because of uncertainty or high cost of importing wood, the mills must find a permanent solution in restoration of nearby forests.

The local wood shortage is confined to softwood species. Most mills have access to all the aspen they can use, and most would have little or no trouble obtaining oak, maple, beech, or elm, if they were able to use it. The problem, therefore, is being approached from two angles: (1) increasing the supply of softwoods, and (2) increasing the use of hardwoods.

A considerable number of the pulp companies are acquiring forest land restocked with pine, spruce, or balsam fir, and a few are engaged in reforesting land on a fairly large scale. Very few of them, however, can expect to obtain more than 20 to 30 percent of their wood requirements from their own lands. The pulp companies therefore are active in educational campaigns and extension work among farmers and other landowners—activities which should have beneficial effects upon the wood supply in the not too distant future. In many cases they will be heavily dependent upon the timber yields from public forests.

Pulp mills have been using increasing quantities of aspen, usually in mixture with softwood species. They consumed more than 600,000 cords in 1946—practically ten times as much as in 1935. A few are utilizing other hardwoods on a small scale.

The Forest Products Laboratory, Madison, Wis., has found experimentally that most hardwood species can be pulped by the sulfate process and that hardwood pulp blended with longer-fibered softwood pulp often gives improved sheet properties. The Laboratory also has developed semichemical processes for hardwoods which yield a wide range of pulps from the finer grades to those used for corrugating board (*4*).

Another field for expansion in use of aspen, willow, and other soft-textured hardwoods is in mechanical defiberization for filler in composition roofing, floor covering, and similar products.

If the Lake States pulp and paper industry gives sufficient emphasis to reforestation and other measures for restoring local softwood sources, and can adapt its processes to a steadily increasing use of hardwoods, it will have no need to view the future with pessimism (*1, 7*).

Other Wood-Processing Mills

About 420 mills, other than sawmills and pulp mills, participated in converting Lake States timber into useful products in 1946. These products included hardwood veneer, slack cooperage, excelsior, wood distillation, lath and shingles. Approximately 60 were specialty mills.

These industries employed about 6,400 persons, exclusive of woods workers, in 1945.

Hardwood Veneer Mills

Eighty-five Lake States mills were engaged in making some type of hardwood veneer in 1946 (table 23). Output of the industry in the region has been rising gradually (fig. 30).

Of 29 standard veneer mills, 15 were specializing in higher grade veneers requiring high-quality logs, mostly yellow birch and sugar maple. The others were producing commercial veneer mainly from No. 2 sawlogs of maple, basswood, birch, and elm. All sought timber 12 inches or larger in diameter and in standard (8- to 16-foot) log lengths, of which they used more than 85 million board feet in 1946 (table 24).

The container veneer mills were turning out veneer for such products as round cheese boxes, wire-bound crates or boxes, and fruit baskets. They used nearly 30 million feet of logs from a wide variety of hardwoods, including soft maple, elm, beech, oak, and aspen. Also, they used 18,900 cords of small bolts 6 to 8 inches in diameter and 33 to 51 inches long for header stock.

TABLE 23.—*Number of hardwood veneer mills and wood consumed, Lake States region, 1946*

State	Total number mills	Standard mills		Container mills		
		Number	Veneer log consumption	Number	Veneer log consumption	Bolt consumption
			Thousand board feet		*Thousand board feet*	*Cords*
Minnesota	8	0		8	900	
Wisconsin	55	23	60, 600	32	7, 800	18, 400
Michigan	22	6	24, 700	16	20, 800	500
Region total	85	29	85, 300	56	29, 500	18, 900

TABLE 24.—*Wood consumed in hardwood veneer mills, Lake States region, by species, 1946*

Species	Logs [1]			Bolts [2]
	All mills	Standard mills	Container mills	
	Thousand board feet	*Thousand board feet*	*Thousand board feet*	*Cords*
Sugar maple [3]	41, 300	32, 600	8, 700	800
Yellow birch	31, 500	30, 200	1, 300	400
Basswood	10, 800	8, 600	2, 200	2, 500
Elm	18, 500	6, 600	11, 900	1, 600
Beech	5, 900	2, 600	3, 300	
Oak	3, 200	2, 600	600	100
Aspen and cottonwood	1, 600	700	900	12, 600
Miscellaneous [4]	2, 000	1, 400	600	900
Total	114, 800	85, 300	29, 500	18, 900

[1] Board-foot volume, International ¼-inch rule.

[2] Standard cords rough wood basis.

[3] Includes small amount of red maple.

[4] Includes ash, walnut, and black cherry from local sources, and a few imported logs.

Excelsior Mills

Eight excelsior mills remained in the region after the only Minnesota plant was destroyed by fire in 1946 and two of the Wisconsin plants were closed and dismantled. These 8 mills, 5 in Wisconsin and 3 in Michigan, employed nearly 300 men, consumed 95,500 cords of wood, and produced roughly half of the excelsior made in the United States.

More than 90 percent of the wood used for excelsior is aspen, the only other common species being basswood. Excelsior bolts are cut in 55-inch lengths and usually are slightly larger and clearer than pulpwood. Timber of log size is not desired because it must be split before using.

In recent years excelsior production has varied from about 55,400 cords in 1936 to 95,500 cords in

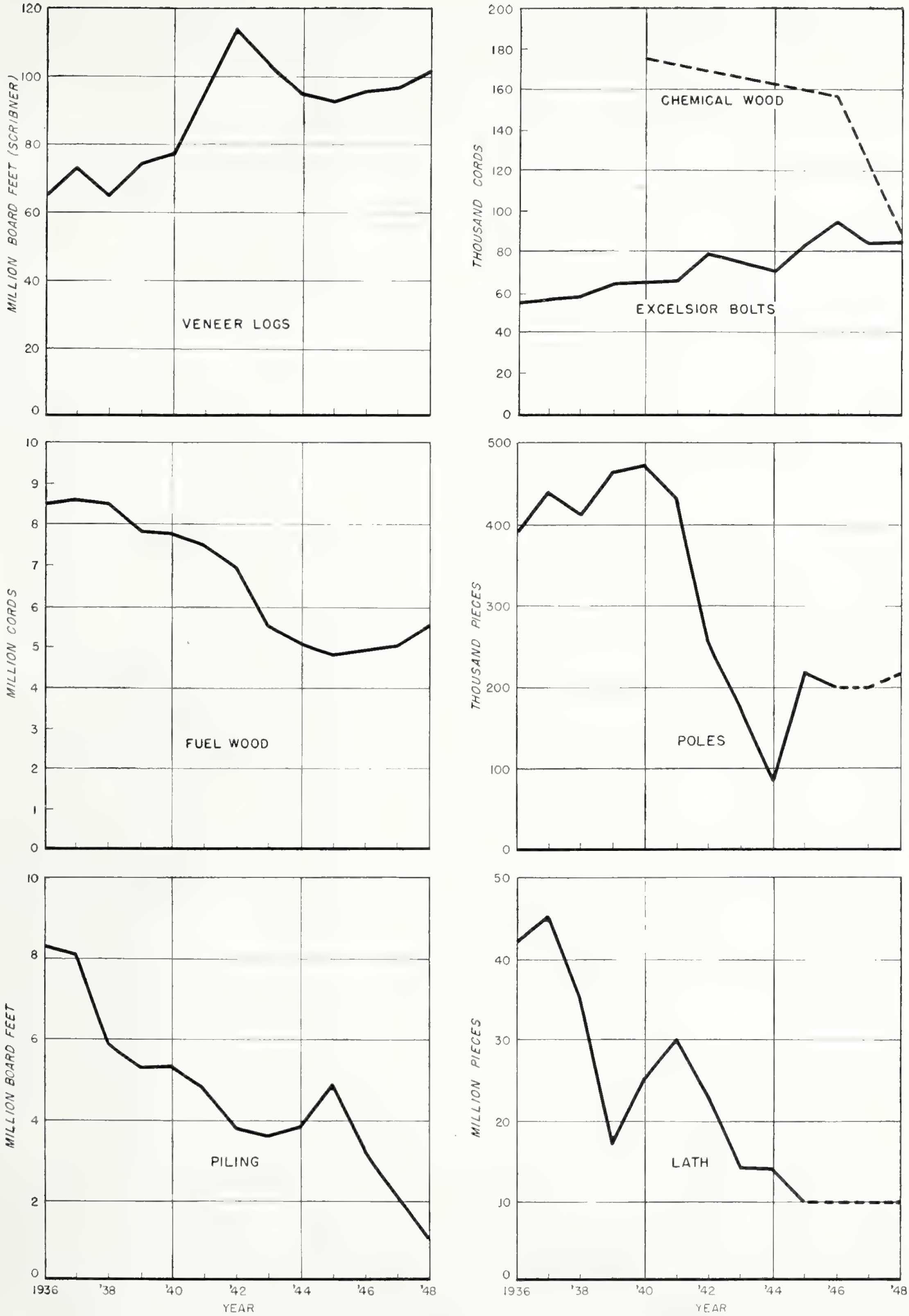


Figure 30.—*Trends in production of seven forest products in the Lake States region, 1936–48.*

1948 (fig. 30). No reason appears for any sharp change in production in the near future. Wood supplies should be adequate, but some companies may have to operate over a wider radius than heretofore.

Wood Distillation Plants

Only three hardwood distillation plants were in operation in 1946, one in Wisconsin, two in Michigan. These consumed about 157,000 cords of wood, mostly birch, beech, and maple, of which approximately 100,000 cords were cull or other salvage material. Wood used in 1948 by distillation plants totaled only 82,000 cords, about half the amount used in 1946, and only 16 percent of the amount used in 1925 (fig. 30).

Chemical wood operations can be very beneficial to the northern hardwood forests, by removing defective trees, salvaging badly suppressed small trees, and generally cleaning up the woods. Likewise, they can improve utilization when combined with lumbering operations, by taking in the slabs, cull logs, and top sections. The remaining mills have progressed far along these lines.

The long-time trend in chemical wood conversion has been downward in this region, but may now have been stabilized inasmuch as the remaining companies enjoy special advantages of one kind or another. Development of new products is always a possibility. Raw material is available for additional plants.

Slack Cooperage Mills

Only seven mills were manufacturing staves from local timber in 1946. Three were in Minnesota, four in Wisconsin. Together they consumed 3.3 million board feet and 3,600 cords of hardwood logs and bolts.

The Lake States cooperage industry still is important in that it supplies the needs of local dairies and meat packing plants and also because it can use elm and poplar, species not fully utilized elsewhere. Wood supplies are adequate to support this industry indefinitely, provided they are obtained by selective logging over a fairly wide radius.

Lath Mills

Lath manufacture in the Lake States is relatively insignificant today. In 1945, 87 mills (20 in Minnesota, 59 in Wisconsin, and 8 in Michigan) produced 9,600,000 pieces—only one-fourth the number made 10 years earlier and less than 1 percent of the number sawed in the peak year 1906 (fig. 30). The region contributed less than 1 percent of the Nation's total production in 1945.

Lath mills where they occur are commonly associated with sawmills and make use of slabs, edgings, and other byproducts. A few use round timber from the forest but the drain on standing timber at present is not large. Operators prefer softwood species but use some aspen.

If the demand for local lath—now mainly for snow fencing and temporary corn cribs—remains steady, it is likely that future operations will create a somewhat larger drain upon the forest, inasmuch as a number of sawmills from which part of the present supply comes as a byproduct will be closing down.

Shingle Mills

In 1945, 170 shingle mills (32 in Minnesota, 102 in Wisconsin, and 36 in Michigan) produced 9.4 thousand squares—about 4 percent of the number made in 1936, and only a small fraction of 1 percent of the number made during the peak year 1899.

The typical shingle mill in this region is a very small plant operating a few months of the year. Usually it employs 4 or 5 men. For shingle bolts, it uses mostly butt sections of white-cedar, relatively inferior material useful for very little else. A few operators make shingles or shakes from white or red pine, and occasionally one uses other species, even hardwood.

Because of the small size of the industry and the short length of bolts used, it can be considered a useful supplement to, rather than a competitor with, other wood-using industries.

Producers of Rough Forest Products

Fuel Wood

Farmers and commercial cutters produced an estimated 5.5 million cords of firewood in 1948. They obtained about 64 percent of this by salvaging slabs and edgings from sawmills, cores from veneer mills, tops and limbs from logging operations, small trees from land clearing, cull trees from farm woods and shelter belts, and used railroad ties, fence posts, and old lumber (table 25). About 2 million cords were obtained by cutting commercial timber trees. The use of fuel wood is declining even in rural areas (fig. 30).

TABLE 25.—*Estimated fuel wood cut from commercial timber and salvage material, Lake States region, 1948*

State	Total	Commercial timber			Salvage material, all species
		All species	Softwoods	Hardwoods	
	Thousand cords	*Thousand cords*	*Thousand cords*	*Thousand cords*	*Thousand cords*
Minnesota	1,600	590	70	520	1,010
Wisconsin	2,000	710	70	640	1,290
Michigan	1,900	700	30	670	1,200
Region total	5,500	2,000	170	1,830	3,500

Fence Posts

An estimated 27 million fence posts were cut on farms and commercial logging operations in 1946. The farm-cut posts were mostly hardwood—oak, aspen, and miscellaneous species. The commercial cuttings were mostly cedar with a small proportion of tamarack, jack pine, and aspen. Production of posts has been declining.

Poles and Piling

Approximately 200,000 poles were produced in the region in 1946. Most of the 169,000 cedar poles were of small size (18 to 25 feet) and were used for farm telephone lines and like purposes. The 26,000 pine poles were logged primarily for the rural electrification cooperatives and were in lengths up to 45 feet. In addition, some 5,000 poles of tamarack, oak, and miscellaneous species were produced for local use. The rate of pole production has been declining since 1935 (fig. 30).

Production of piling totaled about 300,000 board feet in 1946. The trend in piling production also has been downward (fig. 30).

Mine Timbers

Iron and copper mines consumed nearly 11 million board feet of timbers and 25,700 cords of poles and lagging in 1946. All of this material was cut from nearby forests.

Mines were unusually active during the war and consumed large quantities of timber. However, they may use considerably less in the future unless some unforeseen developments again stimulate underground mining.

Miscellaneous Rough Products

About 3 million board feet of sawlogs and 3,200 cords of merchantable pole timber were cut in 1946 for such purposes as cabin logs, bridges, garden poles, rustic furniture, and ornamental fencing. Also, several million spruce and balsam fir saplings were cut for Christmas trees, while boughs, cones, nuts, fruits, and maple syrup provided means for a significant local industry. Activities connected with these products mostly are increasing.

Timber Drain

HOW does the present rate of timber depletion compare with current growth and proposed allowable cut? In making this comparison, it is important to consider not only the amount of the total drain but also its composition as regards species and kind of timber, and the ownership of land from which it comes. Recent and prospective trends in rate of cutting also are significant.

During the fairly representative year 1948, drain on the Lake States forests caused by cutting was approximately 675 million cubic feet, including 1,460 million board feet of live saw timber. The largest share, about 42 percent, was in Michigan (table 26).

TABLE 26.—*Estimated cutting drain on primary growing stock in the Lake States region, 1948*

State	All timber			Saw timber		
	All Species	Soft-woods	Hard-woods	All Species	Soft-woods	Hard-woods
	Million cubic feet	*Million cubic feet*	*Million cubic feet*	*Million board feet*	*Million board feet*	*Million board feet*
Minnesota	185	90	95	265	115	150
Wisconsin	205	60	145	435	135	300
Michigan	285	90	195	760	250	510
Region total	675	240	435	1,460	500	960

Cutting for lumber caused approximately 45 percent of the cubic-foot drain in 1948 and 70 percent of the drain on saw timber. Other important drain items were pulpwood, fuel wood, and veneer (table 27 and fig. 31).

Significantly, nearly one-fourth of the lumber sawed in the Lake States in 1948 was obtained from pole-size trees. On forest lands close to villages and resort developments especially, pole-size trees of jack pine, aspen, and some other species were sawed into construction lumber and box boards. Thus 1,297 million board feet of lumber was equivalent to only 1,018 million board feet of saw timber by current Survey standards.

By far the greater share of current drain is on stands in private ownership. In 1948, approximately 77 percent of all timber drain and 84 percent of

TABLE 27.—*Drain on primary growing stock, by timber products in commercial units and Forest Survey equivalents, Lake States region, 1948*

Product and quantity produced, 1948	Equivalent volume of wood [1]	Equivalent drain on standing timber [2]	
	Million cubic feet	*Million board feet* [3]	*Million cubic feet*
Lumber logs, 1,297 million bd. ft. [4]	201.2	1,018	305.2
Veneer logs, 106 million bd. ft. [5]	19.5	130	25.5
Veneer bolts, 16.2 thousand cords	1.2	—	1.5
Cooperage logs, 2.0 million bd. ft. [5]	.3	3	.5
Cooperage bolts, 1.8 thousands cords	.2	—	.2
Pulpwood logs, 25.4 million bd. ft. [5]	4.2	27	5.2
Pulpwood bolts, 2,130 thousands cords [6]	154.4	78	162.7
Excelsior bolts, 73 thousands cords [7]	6.3	1	6.7
Chemical wood, 89 thousand cords	6.1	12	3.2
Lath, 9.6 million pieces	.2	—	.1
Shingles, 9.4 million pieces	.2	—	.1
Miscellaneous mill logs, 12 million bd. ft. [5]	1.9	13	3.0
Miscellaneous mill bolts, 25 thousand cords [6]	2.0	1	2.0
Fuel wood, 5,500 thousand cords	357.5	131	124.0
Fence posts, 27 million pieces	22.0	17	25.0
Poles, 216 thousands pieces	1.7	5	1.9
Piling, 275 thousand linear ft.	.2	1	.3
Hewn ties, 19 thousand pieces	([8])	—	.1
Mine timbers, 14.5 million bd. ft. [5]	2.7	17	3.5
Mine poles and lagging, 35 thousands cords	2.5	2	2.8
Miscellaneous round timbers, 3.2 million bd. ft. [5]	.5	4	1.0
Miscellaneous round timbers, 5.3 thousand cords	.3	—	.5
Total	785.1	1,460	675.0

[1] Solid wood without bark.

[2] Includes waste, but does not include wood from nonforest and noncommercial forest lands.

[3] International ¼-inch log scale.

[4] Green tally of lumber cut from logs.

[5] Scribner Decimal C log scale.

[6] Standard cords rough wood in 8-foot lengths.

[7] 55-inch cords.

[8] Less than 50 M.

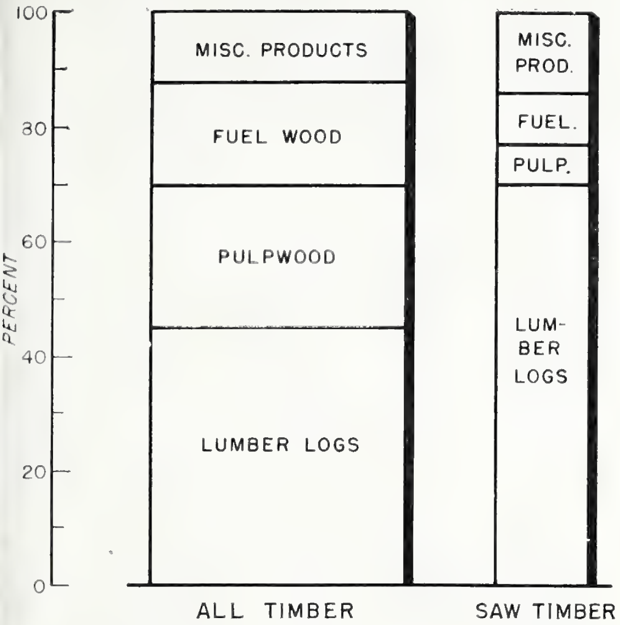


FIGURE 31.—*Proportions of 1948 drain caused by cutting for various products.*

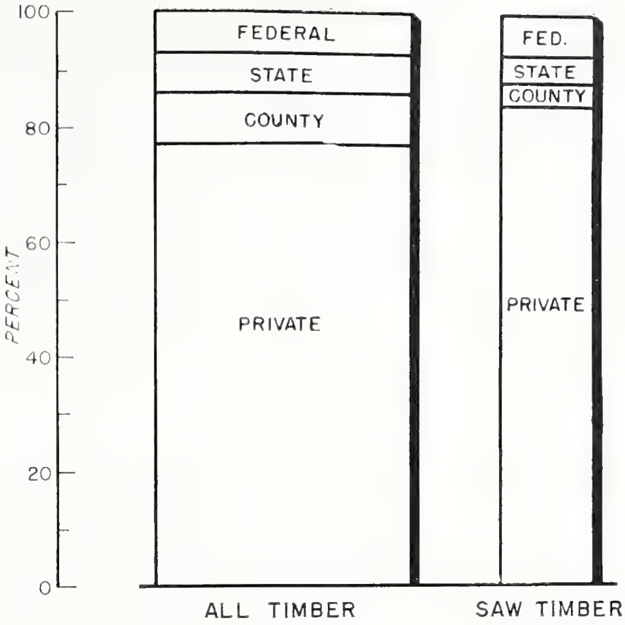


FIGURE 32.—*Proportion of 1948 drain from lands of various owner groups.*

the saw-timber drain was from private lands (table 28, fig. 32).

These figures are subject to some qualification, however. In Minnesota, counties frequently sell land and timber together rather than sell stumpage only. In these cases, the timber cut is charged as drain upon privately owned lands whereas actually it serves to reduce the growing stock on county forests.

Included in the total drain is a certain quantity of unutilized material, either purposely left or lost somewhere in the course of logging operations. The total volume of such material in 1948 was roughly 126 million cubic feet, or 19 percent of the total drain. It included about 60 million board feet of material suitable for logs, or 4 percent of the saw-timber drain.

The bulk of the logging waste accumulates on nonintegrated sawlog operations particularly in less accessible areas where portions of felled trees above the standard log lengths are frequently left on the ground. In many cases this represents from one-third to one-half the total tree volume and includes material suitable for pulpwood, chemical wood, fuel wood, and occasionally for ties, mine timbers, and short logs.

On the other hand, there is a growing number of integrated logging operations in the region, where

TABLE 28.—*Approximate drain from commercial forest land in public and private ownership, Lake States region, 1948*

ALL OWNERS

State	All timber			Saw timber		
	All species	Softwoods	Hardwoods	All species	Softwoods	Hardwoods
	Million cubic feet	*Million cubic feet*	*Million cubic feet*	*Million board feet*	*Million board feet*	*Million board feet*
Minnesota	185	90	95	265	115	150
Wisconsin	205	60	145	435	135	300
Michigan	285	90	195	760	250	510
Region total	675	240	435	1,460	500	960
PUBLIC OWNERS [1]						
Minnesota	85	45	40	150	60	90
Wisconsin	30	10	20	50	15	35
Michigan	40	15	25	40	15	25
Region total	155	70	85	240	90	150
PRIVATE OWNERS [2]						
Minnesota	100	45	55	115	55	60
Wisconsin	175	50	125	385	120	265
Michigan	245	75	170	720	235	485
Region total	520	170	350	1,220	410	810

[1] Based on reports from public agencies and adjusted as accurately as possible to conform to units of measure employed in the Forest Survey.

[2] Residual after deducting drain on public lands from total drain.

various products are sorted for different uses and where waste is held to a minimum. Also a considerable volume of fuel wood and some other products are salvaged in separate operations following logging for sawlogs and veneer, thus reducing losses on these areas.

The wastage of economically useful material is not unduly large but the existence of this unused volume in the face of a growing timber shortage, is a challenge to the landowners, loggers, and mill operators.

Trends in Drain

The rate of timber cutting, and the losses from fires and other destructive agencies declined steadily from 1890 to 1932. From 1933 to 1944, with industrial recovery and the special stimulus of war demands, cutting increased. Since the end of the war drain has shown a tendency to level off or decline (fig. 33).

Drain on saw timber stands was reported slightly more than 2,000 million board feet in the reappraisal (1944). This figure, as well as for other years prior to 1946, included fire and other noncommodity losses which in 1946 and later years have been considered not drain but mortality. Also the 1944 figures included the volume cut from hardwood trees of the 10-inch diameter class, whereas in 1946 and subsequently this has been considered drain on pole timber. Adjusted to a basis comparable to 1944, the drain in 1948 would have been about 1,730 million board feet.

Total drain in cubic feet was reported as 747 million in 1944. Again this included fire and other noncommodity losses amounting to 49 million cubic feet. Also, it included some limb wood of hardwood species omitted from 1948 drain. On a comparable basis, the 1948 drain would have been about 745 million cubic feet.

It is rather significant that while total drain in cubic feet was practically the same in 1944 and 1948, the drain on saw-timber-size trees declined appreciably. It emphasizes a definite trend toward use of smaller timber not only for pulpwood and box bolts but also for lumber, especially lumber for rural construction and for a number of industrial uses.

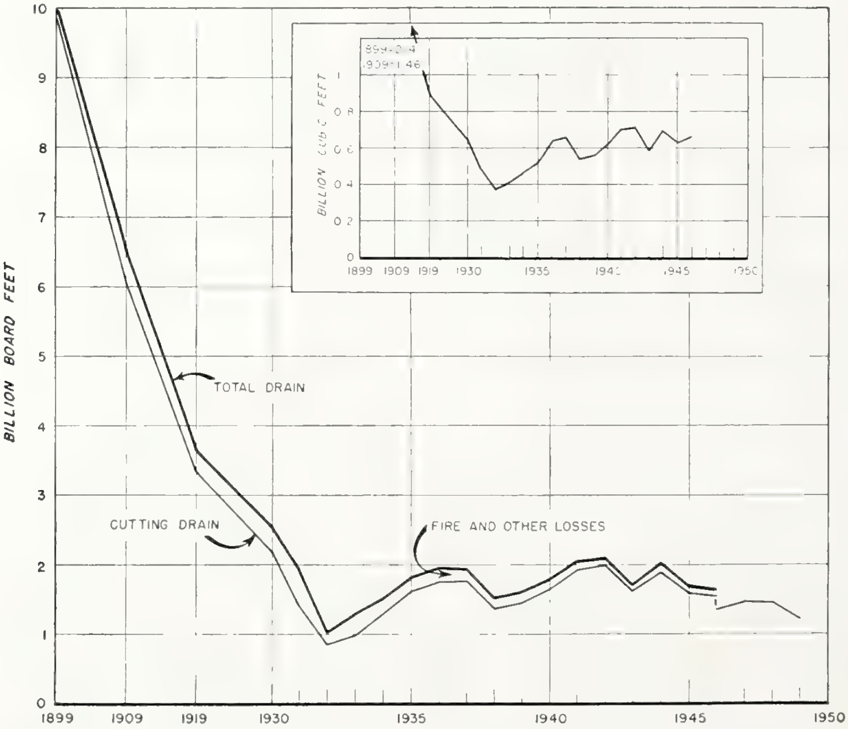


FIGURE 33.—*Drain trends in the Lake States, 1889-1948. (Does not include fire and insect losses after 1945.)*

Allowable Cut

Allowable cut is defined as the quantity of merchantable timber that can be cut annually during specified periods while building up or maintaining a growing stock adequate to fulfill certain future growth goals.

During the next 15 to 20 years, the size of the allowable cut in the Lake States will be controlled not so much by the ultimate growth goal as by the extent and treatment of the remaining old-growth timber, and the rate at which second growth will become sufficiently mature to harvest. It must be influenced to some extent also by imperative needs of existing industries and other pressures tending to hasten the liquidation of merchantable stands.

Speaking broadly, the region has three possible courses in the harvesting of its timber during the next few years. The first, which would be dictated by purely silvicultural considerations, would be to reduce the current rate of cutting of saw timber and high-grade pulpwood very drastically—30 to 40 percent—while increasing the cut of inferior cordwood. This course would stimulate growth rates of desirable species and would hasten the day when much larger yields could be obtained in the future. Inevitably it would have a severe effect upon industrial activity, employment, and other elements of the local economy.

A second possible course, dictated by short-view economic considerations, would be to continue unrestricted liquidation of available saw timber and desirable pulp timber until it is used up, then to cut the second growth as early and as thoroughly as market conditions would permit. By this means most of the existing industries, or replacements, could continue for awhile. In the end, however, the downward adjustment would be equally if not more severe, and full recovery of the forest would be deferred for a longer time.

A third possible course, the one recommended in this analysis, is intermediate. It is based upon the belief that the existing timber stands will support an annual cut of saw timber during the next 20 years, only slightly smaller than during the past 5 years provided certain changes are made in logging and utilization practices. This rate of cutting will defer for a few years the attainment of a high future growth goal, but appears justifiable in view of the economic importance of going industries (fig. 34).

Maintaining the proposed level of cutting will require rather careful budgeting of the remaining supplies of mature timber, and adopting methods of cutting which will reduce mortality, stimulate current growth, and utilize available material more effectively than at present. Some of the specific measures required will be pointed out in the concluding section of this report.

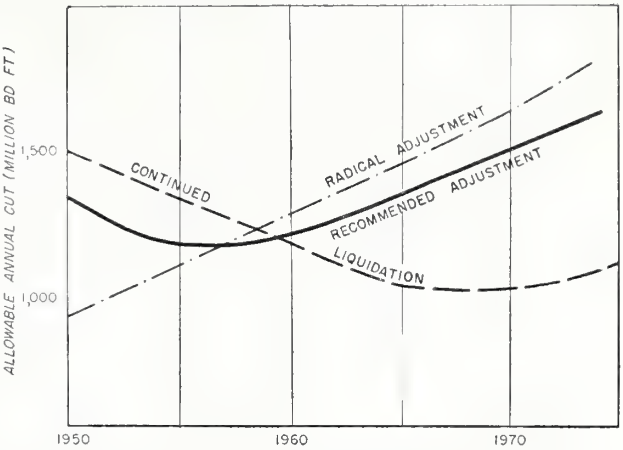


Figure 34.—*Probable results for each of three courses of removing merchantable timber from forests of the Lake States region during the next two decades.*

Following the recommended intermediate course will provide an average annual cut of about 720 million cubic feet, including 1,200 million board feet of saw timber during the decade 1951-60. This can come from various kinds of stands about as shown in table 29 and from lands in different ownerships as shown in table 30.

Allowable Cut in Relation to Growth

Although current net growth and allowable cut are shown as identical in quantity—720 million

Table 29.—*Allowable annual cut from Lake States forests, 1951–60, by stand class*

Stand class	All timber			Saw timber		
	All species	Soft-woods	Hard-woods	All species	Soft-woods	Hard-woods
	Million cubic feet	*Million cubic feet*	*Million cubic feet*	*Million board feet*	*Million board feet*	*Million board feet*
Old growth	90	30	60	360	125	235
Second growth	240	70	170	520	120	400
Pole timber	240	55	185	210	40	170
Seedlings and saplings, and other	150	25	125	110	15	95
Total	720	180	540	1,200	300	900

TABLE 30.—*Allowable annual cut from Lake States forests, 1951–60, by ownership class*

State	All timber			Saw timber		
	All species	Softwoods	Hardwoods	All species	Softwoods	Hardwoods
	Million cubic feet	*Million cubic feet*	*Million cubic feet*	*Million board feet*	*Million board feet*	*Million board feet*
ALL OWNERS						
Minnesota	230	80	150	300	110	190
Wisconsin	215	25	190	380	60	320
Michigan	275	75	200	520	130	390
Region total	720	180	540	1,200	300	900
PUBLIC OWNERS						
Minnesota	140	55	85	170	70	100
Wisconsin	45	10	35	60	15	45
Michigan	75	15	60	70	15	55
Region total	260	80	180	300	100	200
PRIVATE OWNERS						
Minnesota	90	25	65	130	40	90
Wisconsin	170	15	155	320	45	275
Michigan	200	60	140	450	115	335
Region total	460	100	360	900	200	700

cubic feet with 1,200 million board feet of sawlog material—significant differences need to be recognized.

The bulk of the growth is on young thrifty trees just reaching merchantable size, whereas more of the allowable cut is in mature and overmature timber. Only about 15 percent of the cubic-foot growth is in saw-timber stands, while 46 percent of the proposed cut is from such stands. As regards sawlog material, 73 percent of the proposed cut should come from saw-timber stands notwithstanding the fact that annual growth is less than half this quantity (fig. 35).

Net growth, by definition, is merchantable volume being added each year to the primary growing stock. Allowable cut, on the other hand, includes some material which soon would be taken out as mortality if not harvested at the right time. The part of the allowable cut expected to be obtained in the form of thinnings and improvement cuttings which do not detract from growth or inventory amounts to about one-third of the proposed cubic-foot cut and one-fourth of the saw-timber cut (fig. 36).

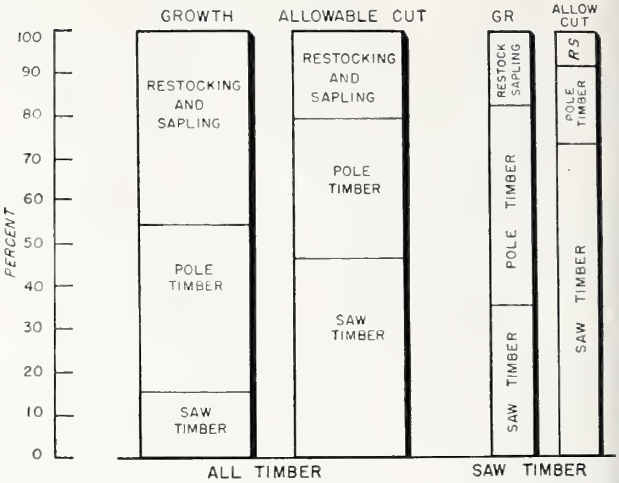


FIGURE 35.—*Comparison of growth and allowable cut with respect to stand class where reported.*

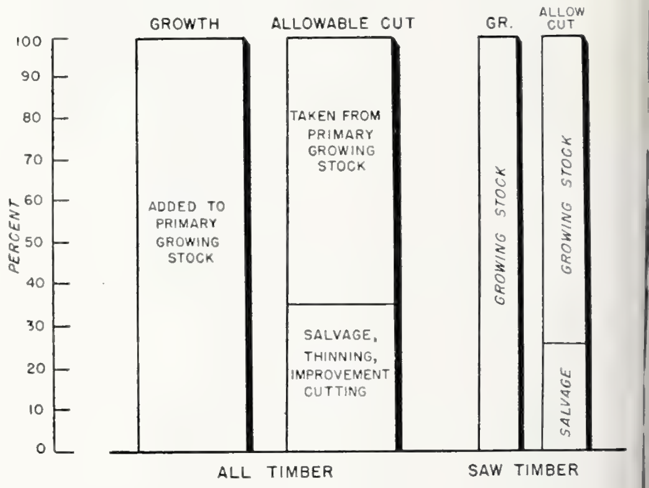


FIGURE 36.—*Comparison of growth and allowable cut with respect to effect on primary growing stock.*

Because of these differences, the proposed allowable cut can be taken each year from the less productive elements of the stand while the annual growth will accumulate and gradually build up the primary growing stock for larger future yields.

Drain in Relation to Growth and Allowable Cut

Total drain in cubic feet, all species combined, was somewhat less than growth and allowable cut during the fairly representative year 1948. However, cubic-foot drain on softwood species was greater than the recommended quantity and if continued will tend to reduce annual growth of these preferred species. Also, drain on sawlog material was more than the proposed annual cut (fig. 37).

In contrast with overcutting of softwood species, drain on hardwoods was less than the proposed allowable cut and in the case of aspen was far below (fig. 38).

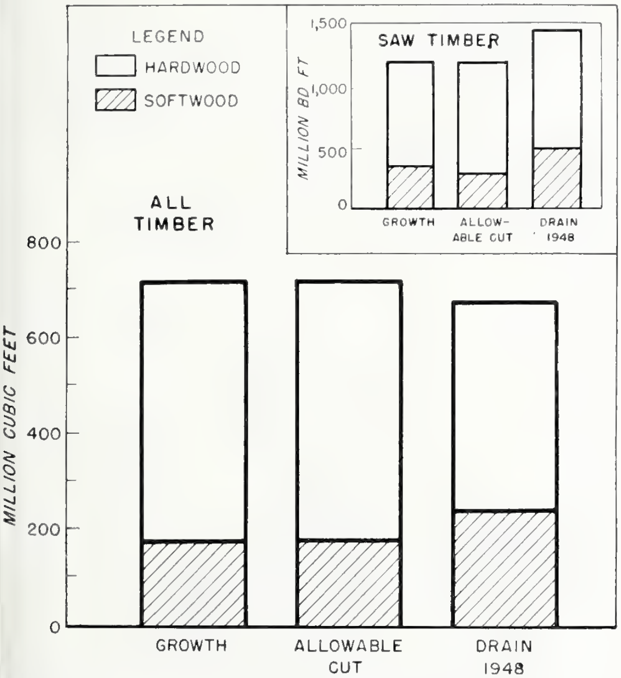


FIGURE 37.—*Comparison of growth, allowable cut, and 1948 drain by species groups—all timber in million cubic feet, saw timber in million board feet.*

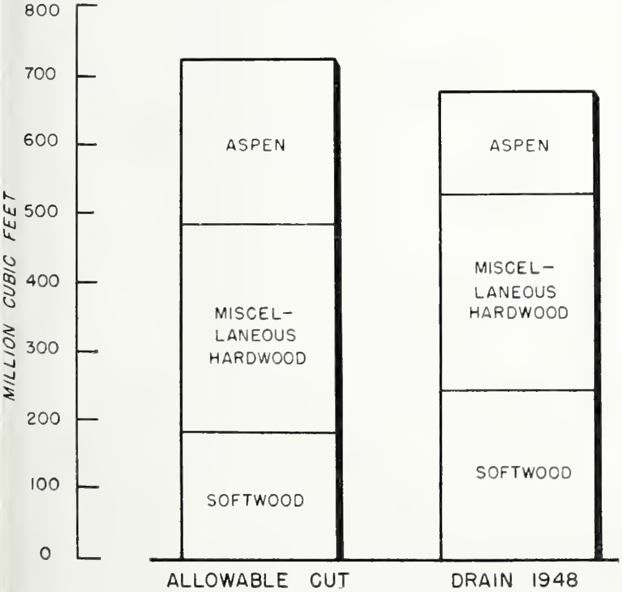


FIGURE 38.—*Comparison of 1948 cubic-foot drain with allowable cut by species groups.*

In addition to being excessive on sawlog timber, especially softwoods, drain exceeded allowable cut in coniferous cordwood mainly because of heavy cutting of pine and spruce for pulp. On other cordwood, drain fell short of the recommended cut by a wide margin (fig. 39).

Drain exceeded allowable cut on privately owned lands but was less than allowable on public lands (fig. 40).

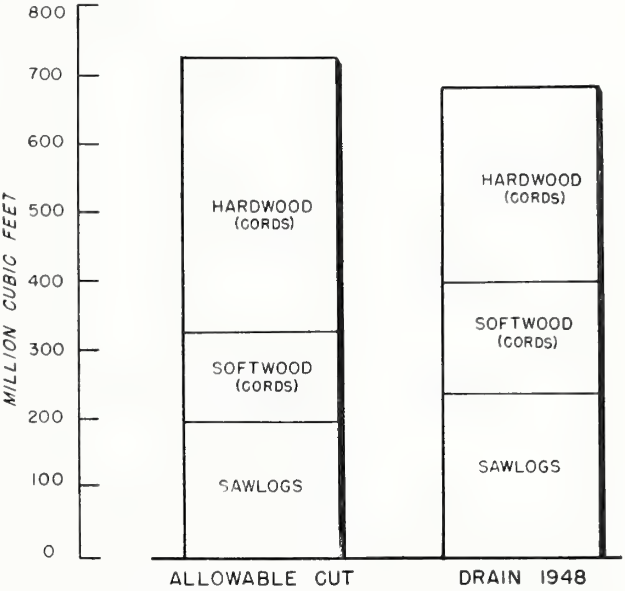


FIGURE 39.—*Comparison of 1948 cubic-foot drain with allowable cut, by kinds of timber.*

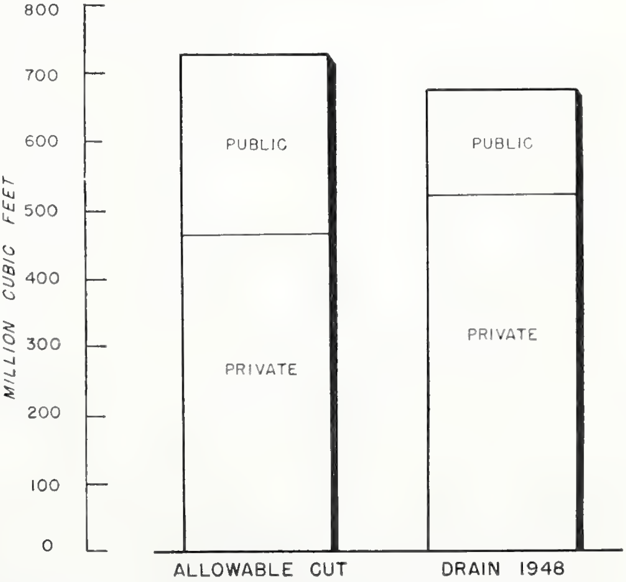


FIGURE 40.—*Comparison of 1948 cubic-foot drain with allowable cut, by owner groups.*

The margin of additional allowable cut over drain was entirely in Minnesota, where the relatively greater distance to market and the somewhat more difficult logging conditions tended to slow the rate of cutting. In Wisconsin and Michigan, cutting rates were in rough balance with productive capacity except with respect to the above mentioned maladjustments in species, kinds of material, and ownership (fig. 41).

Throughout the region, drain was heaviest in relatively accessible areas close to roads and mills, whereas much of the volume proposed for cutting is in more remote areas where timber now is going to waste. Moreover, some of the drain consisted of material obtained from premature clear-cutting of young stands and other forms of destructive logging rather than the good cutting practices envisioned in the allowable cut proposal.

In conclusion, it can be said that the total growing stock of all timber in the Lake States is on the increase but because of various maladjustments, too large a proportion of the new material is relatively inferior in quality and location. To bring the cut into proper balance with the allowable cut will not require any severe reduction in total quantity cut, but will call for further shifts from softwoods to hardwoods, shifts in geographical location of cutting operations, and further improvement in cutting methods.

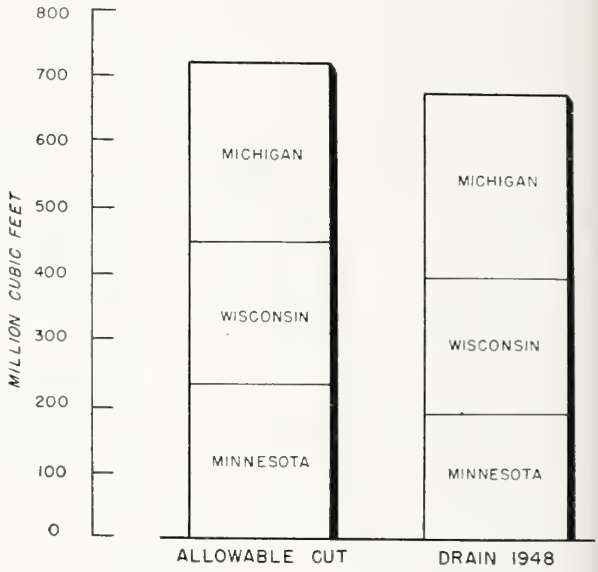


FIGURE 41.—*Comparison of 1948 cubic-foot drain with allowable cut, by States.*

Future Production Goal

To JUDGE the region's need for timber resources and the size of a reasonable growth goal, one must consider not only the demands of existing industries, but also the current wood consumption of the population, the prospects for future needs, and of course the capacity of the forest to produce.

Current Consumption

Industries and consumers in the Lake States use half again as much forest products (more than twice as much saw timber) as is cut from the timberlands of the region. Of 2½ billion board feet of lumber used in the Lake States in 1943, local industries provided less than half, and less than one-quarter of the softwood lumber used (*23*). Of the wood fiber used by the pulp, paper, and board industry, local forests provide about two-thirds. The region does not produce all of the veneer and cooperage used, and appreciable quantities of railroad ties, poles, and piling must be imported. Only in such items as fuel wood and fence posts is it self-supporting.

Total current consumption, translated into terms of standing timber, amounts to about 980 million cubic feet, of which 600 million are softwood. This may be compared with local production (1948 drain) of 675 million cubic feet, including 240 million cubic feet of softwood.

Current consumption of sawlog products in standing timber equivalents is 3,000 million board feet, with 1,900 million softwood (table 31). This may be compared with local production (1948 drain) of 1,460 million board feet total, including 500 million softwood.

Potential Future Requirements

No one is in a position to forecast accurately how much and what kind of timber will be needed in the Lake States in the future. Anyone who has responsibility for managing forest land, however, must make certain assumptions in these matters. He can be guided by studies which have been made of prospective national needs, as well as by certain local trends.

The Forest Service has estimated potential national timber requirements of 15.6 billion cubic feet,

TABLE 31.—*Estimated current annual consumption of timber products in the Lake States region, and Forest Survey equivalents*

Product	Annual consumption rate	Saw-timber equivalent			All-timber equivalent		
		All species	Softwoods	Hardwoods	All species	Softwoods	Hardwoods
		Million board feet	*Million board feet*	*Million board feet*	*Million cubic feet*	*Million cubic feet*	*Million cubic feet*
Lumber	2.5 billion board feet [1]	2,380	1,670	710	510	370	140
Pulpwood	3.0 million cords [2]	250	210	40	250	195	55
Fuel wood	5.0 million cords [3]	124	6	118	130	10	120
Miscellaneous mill products	(4)	218	1	217	47	4	43
Miscellaneous round products	(5)	28	13	15	43	21	22
Total		3,000	1,900	1,100	980	600	380

[1] As of 1943, latest year for which lumber-distribution records were available.

[2] Estimated requirements for domestic paper mills, 1946, including the wood equivalent of imported pulp.

[3] 1946 estimate.

[4] Includes veneer, cooperage, excelsior, etc., estimated about 50 percent greater than regional production in 1946.

[5] Includes poles, posts, piling, and mine timbers.

including about 62.5 billion board feet of saw timber, 50 years hence (*39*). It has proposed a growth goal of 20 billion cubic feet including 72 billion board feet of saw timber to meet domestic needs, permit some exports, and insure ample supplies for national security.

The Lake States region has 8½ percent of the Nation's population, more than 9 percent of its farms, 9½ percent of its railroad mileage, 10 percent of its construction activity, and 12 percent of its manufactures. Thus its people and its industries could be expected to require at least the quantities shown in table 32 which amount to only 8.3 percent of the estimated total cubic-foot requirements and 6.4 percent of the forecast of national saw-timber requirements.

The total potential requirement 50 years hence in terms of standing timber is 1,300 million cubic feet, nearly twice the present allowable cut (fig. 42). This provides no margin for possible new uses nor for a security reserve such as was included in the national growth goal (*39*).

Capability of the Land

In order to supply potential requirements for timber products plus a margin for export, new uses, and security, the Forest Service, United States Department of Agriculture (*39*), has proposed a national growth goal which includes 3,100 million board feet and a total volume of 1,150 million cubic feet annually from the Lake States. It did not specify kinds of wood, but consumption habits suggest that at least one-third of the saw timber and an even larger proportion of the total cubic volume should be softwood. Can this goal be reached by feasible management?

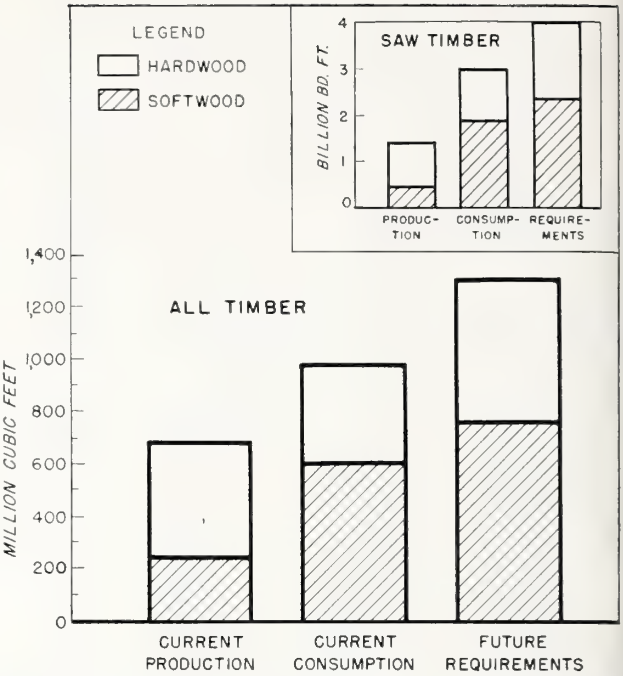


FIGURE 42.—*Comparison of current production of timber products (1948 drain) with approximate current consumption and with potential future requirements.*

Yields from Natural Stands

It has been shown that growth and yields from existing stands and naturally restocked areas can be increased greatly by selective logging, closer utilization, opening up inaccessible tracts, salvaging damaged and defective timber, substituting inferior

TABLE 32.—*Potential annual requirements for timber products in the Lake States 50 years hence, and Forest Survey equivalents*

Product	Assumed requirements	Saw-timber equivalent			All-timber equivalent		
		All species	Softwoods	Hardwoods	All species	Softwoods	Hardwoods
		Million board feet	*Million board feet*	*Million board feet*	*Million cubic feet*	*Million cubic feet*	*Million cubic feet*
Lumber	3.3 billion bd. feet [1]	3,100	2,100	1,000	670	450	220
Pulpwood	4.0 million cords [2]	330	230	100	330	250	80
Fuel wood	6.0 million cords	150	10	140	150	10	140
Miscellaneous mill products	([3])	370	40	330	90	10	80
Miscellaneous round products	([3])	50	20	30	60	30	30
Total		4,000	2,400	1,600	1,300	750	550

[1] 8½ percent of estimated national total, in proportion with population.

[2] 10 percent of estimated national total, compared with 17.4 percent in 1945.

[3] 8 percent of estimated national total.

species for those in short supply, and other measures of good forest management.

By these measures, annual yields of all timber could be stepped up to 1,150 million cubic feet in less than 70 years, but the saw-timber goal of 3,100 million board feet would take several decades longer. Moreover, the increased yields from natural stands would be largely of aspen and other hardwoods.

To hasten the accomplishment of the proposed regional goal, especially to increase the proportion of softwoods for both lumber and pulpwood, a planting program seems desirable.

Additional Yield from Plantations

Landowners have been planting an average of around 40,000 acres per year in the Lake States in recent years. Public agencies planted considerably more than this for several years following 1934 while the Civilian Conservation Corps was active. However, they suspended most planting during World War II and have not yet resumed operations on a large scale. Farmers, with aid from the Federal and State Governments, have been increasing their planting of windbreaks and shelter belts, and some industrial forest owners have been planting on an increasing scale.

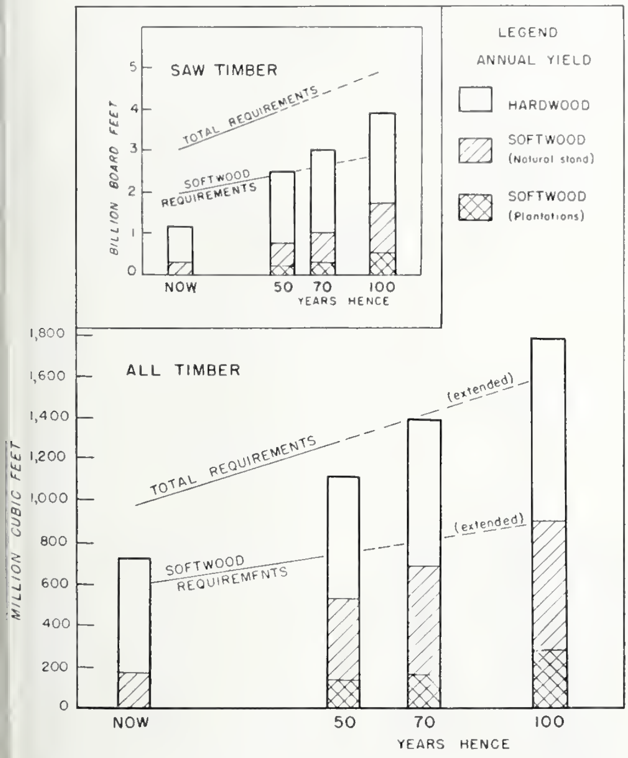


Figure 43.—*Potential future yields under proposed plan of management, as related to Lake States timber requirements.*

To insure production of the quantity of softwood timber needed to reach the regional goal, the rate of planting should be increased very soon to at least 100,000 acres per year. This would accomplish reforestation of 5 million acres in 50 years.

Assuming that the new plantings would be 40 percent red and white pine, 40 percent jack pine, 14 percent spruce, and 6 percent hardwoods, it would be reasonable to expect some yields in the form of pulpwood after 30 years and appreciable quantities of saw timber after 70 years.

By combining good management of natural stands with planting of 5 million acres, the region could attain the proposed 3.1-billion-board-foot goal by A. D. 2020. At that time, it could supply its prospective requirements for hardwood timber of practically all kinds, pulpwood, and fuel wood, in fact, nearly everything except softwood saw timber. In this one particular, it apparently must continue to import softwood lumber from other regions, or alter its consuming habits (fig. 43).

Logical Forestry Objectives

The facts of the situation seem to suggest at least two desirable objectives:

To rebuild the region's forests.—That is, to initiate a program of forest development which will make the region more nearly self-sufficient in timber products, and at the same time augment the incidental values which go with a productive forest. An annual yield of 3.1 billion board feet of saw timber, including 1.1 billion board feet of softwoods, by A.D. 2020 is an attainable goal. This will meet the Lake States share of a proposed national goal, and will supply a large share of the wood products needed for local consumption. It will increase local job opportunities, increase tax revenues, and improve the general economy of the region. The rebuilt forest will also contribute more toward erosion control, farm improvement, and recreational development.

To sustain going industries.—Which means to manage the present timber resources in such a way as to support as large a number as possible of desirable existing industries on a stable and permanent footing, and if possible to encourage new industries in appropriate locations. This implies scheduled cutting budgets and high degree of cooperation between industries and landowners.

How Goal Can Be Reached

Major Facts Shown by Survey

BEFORE attempting to decide what steps will be essential to reach the proposed goal, it may be well to review briefly the significant facts which have been established.

1. Forests are not now filling local requirements. Lake States forests currently supply less than half of the saw-timber products consumed in the region, and only about two-thirds of the total cubic volume of wood used. Shortages are most critical in softwood saw-timber products where the local forest lands supply less than one-fourth of the quantity used. Significant shortages appear also in coniferous pulpwood, and high-grade veneer timber.

Timber requirements 50 years hence have been estimated one-third greater than at present.

2. Heavy cutting has created a poorly balanced growing stock. Heavy cutting in the past has created a poor distribution of stand classes—too little merchantable timber and far too much sapling, seedling, and deforested area. Until rectified, this unbalanced condition will result in irregular timber yields.

Cutting and burning also have converted large acreages of pine, spruce, and northern hardwood forests to aspen.

Since past logging was concentrated in the most accessible stands and frequently was confined to select species, the remaining mature timber is for the most part relatively inferior in species composition, timber quality, and logability.

3. Growth is unsatisfactory. Current annual growth is relatively low and half the potential growth is lost in mortality caused by mismanagement and natural enemies.

Forest fires, although much less severe than a few decades ago, still kill many young seedlings and saplings, including some in plantations, and of course have a bad effect on future growth.

Insects, disease, storms, etc., destroy a large volume of timber annually, and occasionally a severe epidemic or a wind of tornado force causes near-catastrophic damage.

Livestock on farms destroy many seedlings and in places wild game is very destructive to young growth.

Many of these losses could be prevented by better cutting practices and better utilization.

4. Current drain is too heavy in accessible areas. Over the region as a whole current annual drain, including all species and all kinds of material, is less than the current annual growth of all timber. Drain is also less than the recommended allowable cut of 720 million cubic feet; i.e., cut which Lake States will sustain under a plan of gradually increasing production. In accessible areas, however, drain usually exceeds growth and often serves to reduce growth unduly by removing thrifty, rapidly growing trees. In poorly accessible areas, on the other hand, drain is insufficient and a considerable volume of potential growth is lost because it occurs on trees which, under present conditions, will not be utilized before they die from natural causes.

Drain on softwood species is larger than the growth or allowable cut, even including growth in poorly accessible stands. In contrast, drain on aspen and certain other hardwoods is less than would be desirable. Similarly, the utilization of cull trees and suppressed trees is very incomplete.

5. Rapid liquidation of timber jeopardizes many existing forest operations. Cutting out of nearby timber stands of softwoods and preferred hardwoods has forced many large sawmills to close in recent years and continuation of the practice unquestionably will force further closures. Heavy, and in some cases premature, cutting of spruce and pine pole-timber stands has been a factor in causing pulp-mill operators to look to Canada and Montana for an increasing share of their wood. Even with

good protection and management in young forests, there is danger of a hiatus between the last cut of old timber and the first substantial yields from the new. This gap can be disastrous to forest industries.

6. Long-run potentialities of the Lake States forests are good. With good management over a period of 70 years, the Lake States forests could be made to yield twice as much cubic volume annually as at present and two and one-half times as much saw-timber volume. Later they could yield even more.

To attain the larger yields, of course, will require definite improvements in forest management.

7. Mixed and unstable ownership complicates forest management. Publicly controlled forest land, amounting to 41 percent of the total, is administered by a number of different Federal, State, and local agencies, with somewhat differing policies and objectives. Some is widely scattered and not yet under any definite plan of management. Some northern counties, custodians of large acreages of cut-over forest land, for financial reasons are unable to give the lands the kind of care required.

Only about 11 percent of the privately owned forest land is controlled by forest industries. The rest is held by thousands of farmers and other independent landowners. Relatively little of it is being held for permanent forest management. In some localities, a heavy general property tax or uncertainty as to future taxes tends to discourage private forest management. Special yield tax provisions in State laws frequently are inoperative because of local objections.

Public and private lands are rather extensively intermingled. This mixed ownership makes it necessary for wood-using industries to draw their wood supplies from a variety of sources. Because of a lack of integration of cutting plans, the flow of wood from these sources tends to be irregular—a situation unfavorable for both the industries and the local people engaged in woods work.

Specific Measures Needed to Gain Objectives

To build up the forests for larger future yields and at the same time to provide for the essential needs of going industries will require a constructive program along several lines.

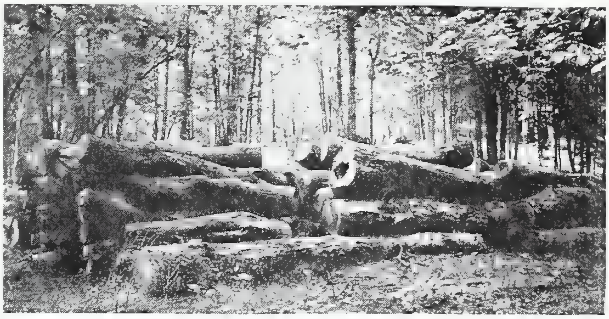
1. Measures to extend life of merchantable stands.

Opening inaccessible areas.—Remote tracts where mature and overmature timber is going to waste should be opened up for marketing as rapidly as feasible. Through construction of access roads to a few large areas and to innumerable small tracts, a considerable volume of additional timber can be put on the market and will remove some of the pressure from the more accessible areas.

Repeated partial cutting.—It has been demonstrated on both public and private forests that selective logging, either for sustained yields or for progressive liquidation, is practicable in northern hardwoods and will add substantially to the total yield over a 20- or 30-year period.

Shift from softwoods to hardwoods.—Industries must find ways to use more aspen, elm, paper birch, red maple, beech, etc., while reducing their use of pine, spruce, and preferred hardwoods. In some localities hemlock and balsam fir are fairly abundant but generally only the hardwoods are in surplus. The forests can support some new industries of the right sort, but will be hurt by additions which make further demands upon declining species.

Improved utilization.—Although the Lake States region has advanced farther than most in utilizing small and defective timber, it should go even farther. Research agencies, as well as loggers and mill men, should concentrate on possibilities for using more short logs, tops, and large limbs now going to waste in the woods, and also upon practicable plans for more closely integrating the woods and mill operations of different industries (fig. 44).



F—445446

FIGURE 44.—*Yields can be substantially increased by closer utilization. Pile of low-grade logs on farm forty in northern Michigan to be used as chemical wood.*

2. Measures to stimulate development of young stands. Anything which will stimulate growth and hasten the maturing of present sapling, pole, and second-growth saw-timber stands will help to bridge the threatened gap in supplies and thus aid in stabilizing industries. Several possibilities deserve attention.

Avoiding premature harvesting.—Owners of thrifty young timber such as northern hardwoods in the small saw-timber stage, or pine and spruce in the small pole-timber stage, should postpone harvest cutting because at this stage the dominant trees have a higher value as growing stock than for timber products. This practice is not serious on well-managed public and private forests, and is being combatted successfully in counties where foresters are employed to give demonstrations and advice to landowners. Elsewhere it needs more attention.

Thinning and weeding.—To obtain needed pulpwood, fence posts, mine lagging, and fuel wood, as well as to improve the quality and vigor of young timber stands, owners should thin overdense stands and take out suppressed, damaged, and unhealthy trees wherever practicable (fig. 45). Farmers can improve their woodlands by removing large, spreading wolf trees.

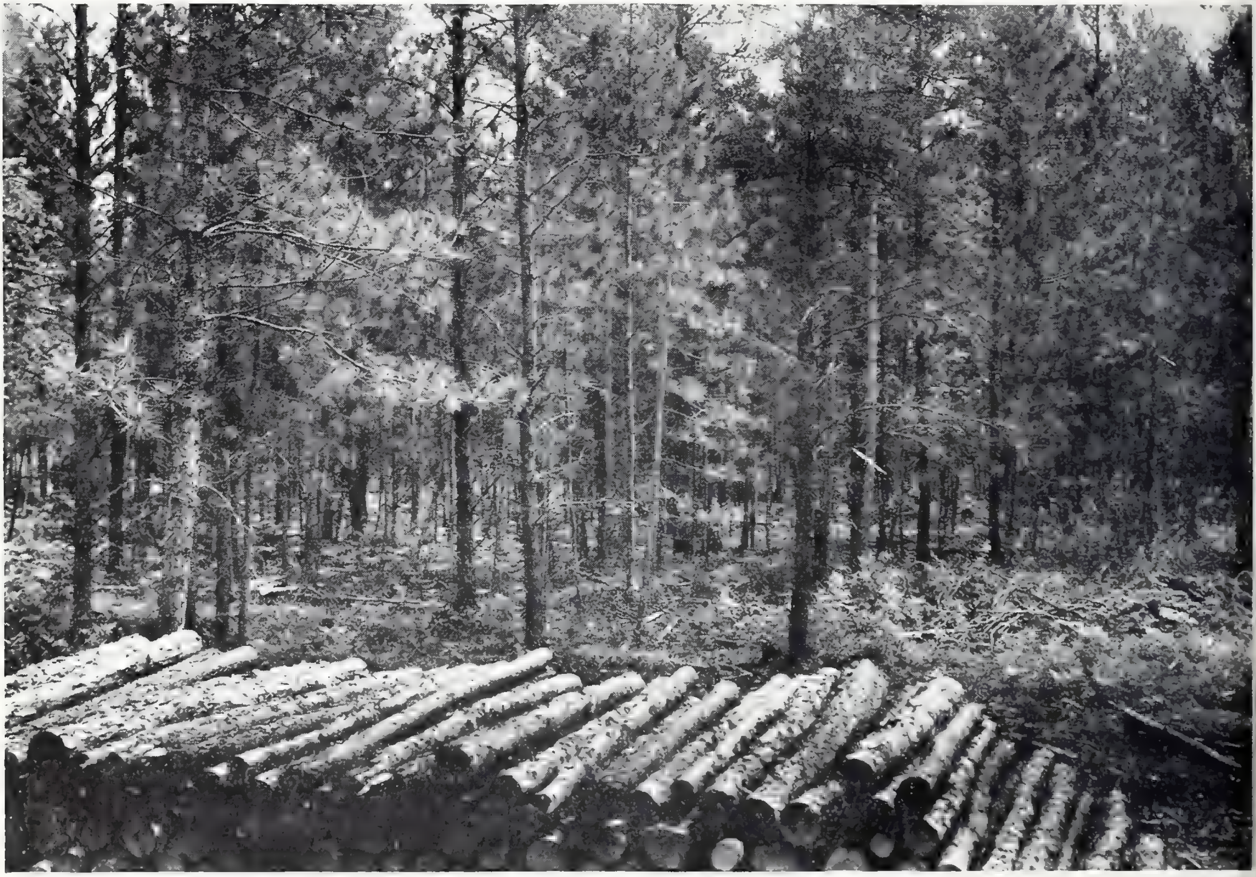
3. Measures to reforest nonstocked and poorly stocked areas.

Improving protection.—Fire protection already has proved effective in encouraging natural reforestation and bringing about a "thickening up" of sapling stands. Because of rising costs and the continuing threat of serious damage, fire protective organizations need strengthening.

The region should have an equally effective system for detecting and controlling incipient outbreaks of insects and diseases threatening young growth.

Reducing animal damage.—In the farm-woods districts, seedlings must be protected from browsing and trampling by livestock if they are to survive and develop into merchantable timber.

In some localities the deer and beaver population must be kept under control unless it is decided that the game is more valuable than the timber.



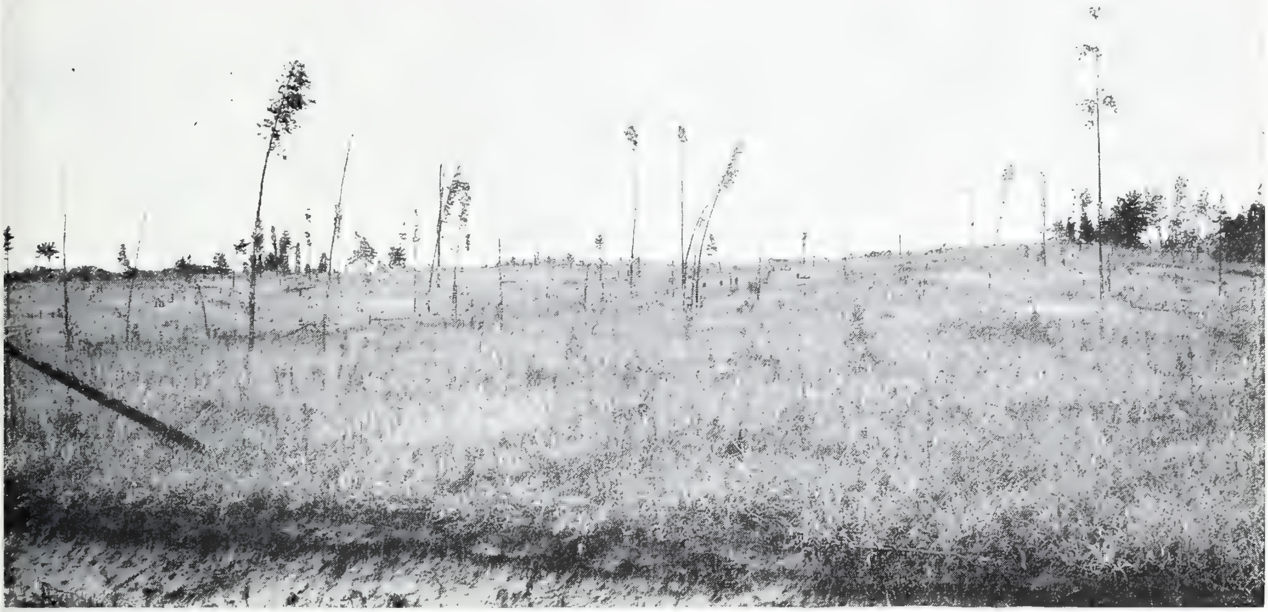
F—421212

FIGURE 45.—*Thinning of dense stands usually will stimulate growth and yield some merchantable products. This stand of young jack pine in north-central Minnesota has been thinned for pulpwood.*

Encouraging natural reforestation.—By maintaining seed trees, preparing suitable seedbeds at time of logging, scattering cone-bearing slash, judicious release cutting, and other practicable forestry measures Nature can be assisted in establishing a desirable forest cover on many areas which otherwise might remain unproductive for long periods (fig. 46).

4. Measures to stabilize ownership and promote sustained yields. Certain adjustments in organization and handling of individual forest properties obviously must accompany the proposed changes in forest management.

Bringing forest lands into stabilized ownership.—Either through action of present owners or by transfer of ownership, a large part of the forest land must come under such control that it can be dedicated to continuous long-range forest management. This has been accomplished on large areas of public land and some industrial holdings. It is still a weak point in the program in the case of (1) a number of minor Federal holdings, (2) undedicated State lands, (3) many county-controlled areas, (4) lands in process of tax-forfeiture, (5) hundreds of thousands of farm woods, and (6) millions of acres of private holdings.



F—431326

FIGURE 46.—*Large areas need reforesting. In this case, leaving more and better seed trees and some preparation of a seedbed might have insured prompt reforestation. As it is, the land probably will have to be planted or remain many years in a very poorly stocked condition.*

Planting.—Protection and good management will insure restocking many areas but cannot be expected to restore pine and spruce sufficiently soon or on a sufficiently large scale. They will not provide all the farm requirements. A 100,000-acre-per-year planting program (2½ times the 1946 rate) is needed.

Areas chosen for planting with softwoods should consist of the better sites, well located with respect to probable future markets, relatively easy to plant, and in ownerships where sustained care will be assured.

The hardwood plantings, presumably mostly on farms, will serve in many cases as shelter belts, erosion control devices, home beautification projects, etc., as well as to augment the farmers' wood supplies.

The situation seems to call for both landowner education and further land acquisition by those owners capable of managing forests constructively.

Consolidating holdings for better administration.—Progress is being made in consolidating State and Federal forests through a program of land exchanges, but much more remains to be done. Counties have done relatively little toward blocking up their forest lands for easier administration. Exchanges between States, counties, and private owners have been few.

Adjustments of this kind cannot be accomplished over night, but an accelerated program of consolidation would greatly facilitate reaching the proposed forestry objectives.

Integrating management plans.—Most public agencies and a number of private owners have or are in the process of preparing plans for forest management, including a forest inventory, a cutting schedule, and a definite system of logging. To be fully effective in the present situation, individual plans need to be correlated. That is, each landowner in making his cutting budget should give attention to the plans of adjoining owners and to the needs of tributary industries. Otherwise the annual production of forest commodities will fluctuate widely with unfavorable effects on prices, local employment, and industrial stability.

Public agencies and industrial owners can integrate their plans by agreement, formal or otherwise. Farmers and other small owners may be able to function better through a producer cooperative or similar form of organization.

Removing obstacles to good management.—Taxes, where they interfere with private forest management, should be adjusted, possibly by some further legislation, but mainly by clearing up local misunderstandings and maladjustments, and establishing more equitable tax assessments.

Financial problems, as where counties have too small a tax base and too high administrative costs to permit them to proceed with desirable forestry measures, may call for additional State aid.

Taking advantage of all available aids.—Full advantage should be taken of all Federal, State, and private programs which will in any way help to accomplish the forestry objective. Useful tools will be found in county farm forestry and extension programs, local agricultural and soil conservation activities, county zoning and planning work, programs of State conservation departments and privately sponsored groups, and research programs of the Federal Government and of educational institutions in each State.

5. Measures to adapt general remedies to local conditions. Forest conditions and economic conditions vary too much from place to place to permit applying the proposed measures broadly to entire States or to a large subdivision. Most of the proposed steps will have to be worked out for small areas such as counties or natural working circles, according to the conditions found in each locality.

The forest survey information used in this report has been sufficient to show the general regional situation and to indicate along broad lines what needs to be done. However, to provide a basis for detailed forestry programs that will implement the general program already outlined, there is need for more detailed information. County surveys, financed jointly by States, counties, private landowners, and the Federal Government, are being made now in a number of counties in the Lake States region. Such surveys will help provide the basis for localized programs of forest management and development.

Literature Cited

(1) Amidon, George.
1947. progress of private forestry in the lake states pulpwood industry. Soc. Amer. Foresters Proc. 1947: 423–433.

(2) Andrews, Horace J., and Bromley, W. S.
1941. trends in land use in northern michigan. a study of alpena, antrim, ogemaw, and roscommon counties. Chas. Lathrop Pack Forestry Foundation. 45 pp., illus.

(3) Black, John D., and Gray, L. C.
1935. land settlement and colonization in the great lakes states. U. S. Dept. Agr. Bul. 1295, 88 pp., illus.

(4) Bray, M. W., Schafer, E. R., and McGovern, J. N.
1944. utilization of less commonly used species and waste and the improvement of yield in pulp manufacture. U. S. Dept. Agr., Forest Service, Forest Products Laboratory Mimeo. R1451. 16 pp.

(5) Bromley, W. S.
1947. sawlog forestry on industrial and large units of private land in the lake states. Soc. Amer. Foresters Proc. 1947: 416–423.

(6) Cunningham, R. N., and White, H. G.
1941. forest resources of the upper peninsula of michigan. U. S. Dept. Agr. Misc. Pub. 429, 32 pp., illus.

(7) Demmon, E. L.
1946. available pulp timber stands in the lake states. Tappi Monog. Ser. 4: 40–51.

(8) Dickerman, Murlyn B.
1944. present indications of future trends in michigan forest industries. Mich. Acad. Sci., Arts, and Letters Papers 30: 193–201, illus.

(9) Eyre, F. H., and Neetzel, J. R.
1937. applicability of the selection method in northern hardwoods. Jour. Forestry 35: 353–358.

10) ——— and LeBarron, Russell K.
1944. management of jack pine stands in the lake states. U. S. Dept. Agr. Tech. Bul. 863, 66 pp., illus.

(11) ——— and Zehngraff, Paul.
1948. red pine management in minnesota. U. S. Dept. Agr. Cir. 778, 70 pp., illus.

(12) Fairchild, Fred Rogers, and associates.
1935. forest taxation in the united states. U. S. Dept. Agr. Misc. Pub. 218, 681 pp., illus.

(13) Fontana, S. G.
1947. forest management of public lands in the lake states. Soc. Amer. Foresters Proc. 1947: 461–471.

(14) Gibson, D. L.
1944. socio-economic evolution in a timbered area in northern michigan. Mich. Agr. Expt. Sta. Tech. Bul. 193, 76 pp., illus.

(15) hatfield, Rolland F.
1940. manufacturing payrolls by county and type in minnesota, 1938. 15 pp. Minnesota Resources Commission, Minneapolis.

(16) Heritage, William.
1936. forestry, past and future, on indian reservations in minnesota. Jour. Forestry 34: 648–652.

(17) Hibbard, B. H., Hartman, W. A., and Sparhawk, W. N.
1929. use and taxation of land in lincoln county, wisconsin. Wis, Agr. Expt. Sta. Bul. 406, 38 pp., illus.

(18) Jesness, Oscar Bernard, Nowell, Reynolds I., and associates.
1935. a program for land use in northern minnesota. 338 pp., illus. Minneapolis.

(19) LeBarron, Russell K.
1948. silvicultural management of black spruce in minnesota. U. S. Dept. Agr. Cir. 791, 60 pp., illus.

(20) Michigan State Planning Commission.
1935. preliminary report on state planning: 1935. [270] pp., illus. [Processed.]

(21) Minnesota Land Utilization Committee.
1934. land utilization in minnesota: a state program for the cut-over lands. 289 pp., illus.

(22) National Resources Committee.
1939. REGIONAL PLANNING. PT. 8. NORTHERN LAKE STATES. 63 pp., illus.

(23) Pierson, Albert H., and Blythe, R. H., Jr.
1945. DOMESTIC LUMBER DISTRIBUTION, 1943. U. S. Dept. Agr., Forest Serv. 21 pp. [Processed.]

(24) Quetico-Superior Committee.
1938. REPORT TO THE PRESIDENT OF THE UNITED STATES ON THE QUETICO-SUPERIOR AREA. 40 pp., illus.

(25) Ramsdell, Willett Forrest.
1933. TOWNSHIP GOVERNMENT AND THE EXPLOITATION OF TIMBER AND WILDLAND RESOURCES IN NORTHERN MICHIGAN. Univ. Mich. 49 pp.

(26) Reynolds, R. V.
1935. HOW MUCH TIMBER HAS AMERICA CUT? Jour. Forestry 33: 34–41, illus.

(27) Schmitz, Henry, and Jackson, Lyle W. R.
1927. HEART ROT OF ASPEN. Minn. Agr. Expt. Sta. Tech. Bul. 50, 43 pp., illus.

(28) Shirley, Hardy L.
1941. RESTORING CONIFERS TO ASPEN LANDS IN THE LAKE STATES. U. S. Dept. Agr. Tech. Bul. 763, 36 pp., illus.

(29) Smith, Norman F.
1947. CONTROLLED BURNING IN MICHIGAN'S FOREST AND GAME MANAGEMENT PROGRAMS. Soc. Amer. Foresters. Proc. 1947: 200–205.

(30) Spalding, Volney Morgan.
1899. THE WHITE PINE (PINUS STROBUS LINNAEUS). U. S. Dept. Agr. Bul. 22, 184 pp., illus.

(31) Sparhawk, William N., and Brush, Warren D.
1929. THE ECONOMIC ASPECTS OF FOREST DESTRUCTION IN NORTHERN MICHIGAN. U. S. Dept. Agr. Tech. Bul. 92, 120 pp., illus.

(32) Stoddard, Charles H., Jr.
1939. THE "TWO-CUT" SYSTEM OF FOREST LIQUIDATION IN THE LAKE STATES REGION. Chas. Lathrop Pack Forestry Foundation. 45 pp., illus.

(33) Stoeckeler, Joseph H., and Arbogast, Carl F.
1947. THINNING AND PRUNING IN YOUNG SECOND-GROWTH HARDWOODS IN NORTHEASTERN WISCONSIN. Soc. Amer. Foresters Proc. 1947: 328–346, illus.

(34) Swift, Ernest.
1947. WILDLIFE AS A FOREST CROP IN THE LAKE STATES. Soc. Amer. Foresters Proc. 1947: 483–490.

(35) Titus, Harold.
1945. THE LAND NOBODY WANTED, THE STORY OF MICHIGAN'S PUBLIC DOMAIN. Mich. Agr. Expt. Sta., Spec. Bul. 332, 44 pp., illus.

(36) United States Bureau of the Census.
1946-47. UNITED STATES CENSUS OF AGRICULTURE: 1945.

(37) United States Forest Service.
1920. TIMBER DEPLETION, LUMBER PRICES, LUMBER EXPORTS, AND CONCENTRATION OF TIMBER OWNERSHIP. Rpt. on Sen. Res. 311. 71 pp., illus.

(38) ———
1935. POSSIBILITIES OF SHELTERBELT PLANTING IN THE PLAINS REGION. 200 pp., illus.

(39) ———
1948. FORESTS AND NATIONAL PROSPERITY: A REAPPRAISAL OF THE FOREST SITUATION IN THE UNITED STATES. U. S. Dept. Agr. Misc. Pub. 668, 99 pp., illus.

(40) United States Office of Indian Affairs.
1940. FOREST CONSERVATION ON LANDS ADMINISTERED BY THE DEPARTMENT OF THE INTERIOR. PT. 2. FORESTRY ON INDIAN LANDS.

(41) Watson, Russell.
1947. COMMERCIAL FORESTRY IN NORTHERN MICHIGAN. Soc. Amer. Foresters Proc. 1947: 436–448.

(42) Wehrwein, George S., and Parsons, Kenneth H.
1933. RECREATION AS A LAND USE. Wis. Agr. Expt. Sta. Bul. 422, 32 pp., illus.

(43) White, Charles H.
1942. HOME-GROWN TIMBER FOR FARM BUILDINGS. Minn. Univ., Agr. Ext. Spec. Bul. 238, 16 pp., illus.

(44) Wilson, Fred.
1947. WISCONSIN COUNTY FORESTS. Soc. Amer. Foresters Proc. 1947: 474–476.

(45) Wisconsin State Planning Board.
1939. THE CUT-OVER REGION OF WISCONSIN. Bul. 7, 150 pp., illus.

(46) ———
1946. A PICTURE OF WISCONSIN. Bul. 16, 120 pp., illus.

(47) Zillgitt, W. M.
1947. STOCKING IN NORTHERN HARDWOODS UNDER THE SELECTION SYSTEM. Soc. Amer. Foresters Proc. 1947: 320–327.

(48) Zon, Raphael, and Duerr, William A.
1942. FARM FORESTRY IN THE LAKE STATES: AN ECONOMIC PROBLEM. U. S. Dept. Agr. Cir. 661, 33 pp., illus.

Appendix

How the Survey Was Made

THE resource data presented in this report are based upon an initial field inventory made in the years 1934–36, corrected and brought up to date as of January 1950.

The original timber inventory (1934–36) was a line-plot cruise in which lines were run east and west at 10-mile intervals, and fifth-acre sample plots were measured every one-eighth mile throughout the forest and woodland sections of each State. The type of forest cover, size class, and density of stand were recorded and trees were measured to get average volumes per acre. This gave a basis for estimating the area of land covered by forests of different kinds as well as the volume of timber thereon (*8*). The statistics were revised by bookkeeping methods in 1945.

Beginning in the fall of 1946, the experiment station, with cooperation of the States and other landowners, made a resurvey of a number of counties and parts of counties. Up-to-date figures on areas, volumes, growth, and allowable cut from these areas were used as background information and as a further means for bringing regional estimates to a current basis.

Current annual growth was estimated on the original survey by use of specially constructed yield tables, discounted for understocked stands. Allowance was made for the fact that trees in understocked forests grow faster than trees of the same species and age in the dense forest. Average mortality from fire, insects, diseases, etc., was estimated from records of previous losses, reduced where killed material was salvaged. Suppression losses were computed from yield tables and from records of permanent sample plots maintained by the experiment station. More recent growth estimates have been made by a stand projection method utilizing borings and mortality data collected on sample plots, thus providing a check on the results from yield tables.

As a basis for commodity drain, a virtually complete canvass of wood-using industries was made in Minnesota in 1934, Michigan in 1935, and Wisconsin in 1937. During the subsequent years, annual or periodic production records were maintained for sawmills, pulp mills, and several other industries. Sampling surveys were made in 1946, 1947, and 1948 to obtain estimates of production of fence posts, poles, mine timbers, and miscellaneous items. Utilization studies were made to assist in converting production figures into drain on standing timber.

Ownership data have been obtained insofar as possible from records of individual owners. The public agencies and most of the large timberland owners have their own cruises and status records. The station was able to obtain abstracts of most of this information. For farm woods and the innumerable small timberland tracts, the measurements on the sample plots were used as a basis of estimation.

Accuracy of Estimates.—The original inventory, based upon 15,000 miles of survey line and 120,000 fifth-acre sample plots, had a calculated sampling error of about 0.7 percent for forest area and 1.1 percent for saw-timber volume. Corresponding errors for single States were 1.2 to 1.9 percent. Errors for individual species, of course, were considerably greater.

The 1945 and 1950 adjustments to calculate volumes were based upon estimates of growth and drain during a 10- to 15-year period since the original survey. Each of these elements, adding up to more than one-third of the initial inventory, contained possibilities of rather large errors, but recent data based upon revised national-forest, State, and industry surveys and the several intensive county surveys made since 1946 were available to strengthen the estimates of area, volume, and ownership. Thus the 1950 estimate of volume, although considerably less accurate than the original estimate, still is a usable figure to portray the over-all situation in the region.

Common and Botanical Names of Principal Tree Species

Trees Included in the Timber Estimates

Recognized Common Name	*Botanical Name*
Ash, black	*Fraxinus nigra* Marsh.
Ash, green	*F. pennsylvanica* var. *lanceolata* (Borkh.) Sarg.

Recognized Common Name	*Botanical Name*
Ash, white	*F. americana* L.
Aspen, bigtooth	*Populus grandidentata* Michx.
Aspen, quaking	*P. tremuloides* Michx.
Basswood, American	*Tilia americana* L.
Beech, American	*Fagus grandifolia* Ehrh.
Birch, paper	*Betula papyrifera* Marsh.
Birch, sweet	*B. lenta* L.
Birch, yellow	*B. lutea* Michx. f.
Boxelder	*Acer negundo* L.
Buckeye, Ohio	*Aesculus glabra* Willd.
Butternut	*Juglans cinerea* L.
Cherry, black	*Prunus serotina* Ehrh.
Chestnut, American	*Castanea dentata* (Marsh.) Borkh.
Coffeetree, Kentucky	*Gymnocladus dioicus* (L.) K. Koch
Cottonwood, eastern	*Populus deltoides* Bartr.
Elm, American	*Ulmus americana* L.
Elm, rock	*U. thomasi* Sarg.
Elm, slippery	*U. fulva* Michx.
Fir, balsam	*Abies balsamea* (L.) Mill.
Hackberry	*Celtis occidentalis* L.
Hemlock, eastern	*Tsuga canadensis* (L.) Carr.
Hickory	*Carya* spp.
Honeylocust	*Gleditsia triacanthos* L.
Hophornbeam, eastern (ironwood)	*Ostrya virginiana* (Mill.) K. Koch
Locust, black	*Robinia pseudoacacia* L.
Maple, red	*Acer rubrum* L.
Maple, silver	*A. saccharinum* L.
Maple, sugar	*A. saccharum* Marsh. [syn. *A. saccharophorum* K. Koch]
Mulberry, red	*Morus rubra* L.
Oak, black	*Quercus velutina* Lam.
Oak, bur	*Q. macrocarpa* Michx.
Oak, northern pin (jack)	*Q. ellipsoidalis* E. J. Hill
Oak, northern red	*Q. borealis* Michx. f.
Oak, scarlet	*Q. coccinea* Muenchh.
Oak, swamp white	*Q. bicolor* Willd.
Oak, white	*Q. alba* L.
Pine, eastern white	*Pinus strobus* L.
Pine, jack	*P. banksiana* Lamb.
Pine, red (Norway pine)	*P. resinosa* Ait.
Poplar, balsam (balm-of-Gilead)	*Populus tacamahaca* Mill.
Spruce, black	*Picea mariana* (Mill.) B. S. P.
Spruce, white	*P. glauca* (Moench) Voss
Sycamore, American	*Platanus occidentalis* L.
Tamarack	*Larix laricina* (Du Roi) K. Koch
Tupelo, black (blackgum)	*Nyssa sylvatica* Marsh.
Walnut, black	*Juglans nigra* L.
White-cedar, northern	*Thuja occidentalis* L.
Willow	*Salix* spp.
Yellow-poplar	*Liriodendron tulipifera* L.

Noncommercial Hardwoods not Included in the Timber Estimates

Alder	*Alnus* spp.
Cherry, pin	*Prunus pensylvanica* L. f.
Dogwood, flowering	*Cornus florida* L.
Hawthorn	*Crataegus* spp.
Hornbeam, American (blue beech)	*Carpinus caroliniana* Walt.
Maple, mountain	*Acer spicatum* Lam.
Maple, striped	*A. pensylvanicum* L.
Mountain-ash, American	*Sorbus americana* Marsh.
Papaw	*Asimina triloba* (L.) Dunal
Plum, American	*Prunus americana* Marsh.
Redbud, eastern	*Cercis canadensis* L.
Sassafras	*Sassafras albidum* (Nutt.) Nees
Willow (shrub species)	*Salix* spp.
Witch-hazel	*Hamamelis virginiana* L.

TABLE 33.—*Approximate acreage of original forest in the Lake States region, by forest type*

Forest type	Region total	Minnesota	Wisconsin	Michigan
	Million acres	*Million acres*	*Million acres*	*Million acres*
White and red pine	24.0	6.0	8.0	10.0
Jack pine				
Spruce–balsam fir	14.0	6.3	3.2	4.5
Coniferous swamp	13.0	6.0	3.5	3.5
Northern hardwood [1]	24.0	4.0	11.0	9.0
Oak-hickory	13.0	3.0	5.0	5.0
Bottom-land hardwood	9.0	3.2	2.8	3.0
Scrub	6.7	5.7	.5	.5
All forest	103.7	34.2	34.0	35.5

[1] Original northern hardwood forest contained a great deal of white pine and hemlock.

TABLE 34.—*Lumber produced in the Lake States region, 1869–1948*

Year	Region total	Minnesota	Wisconsin	Michigan
	M bd. ft.	*M bd. ft.*	*M bd. ft.*	*M bd. ft.*
1869	3, 592, 202	242, 390	1, 098, 199	2, 251, 613
1879	6, 284, 605	563, 974	1, 542, 021	4, 178, 610
1889	9, 970, 274	1, 309, 887	3, 182, 029	5, 478, 358
1899	8, 749, 842	2, 342, 338	3, 389, 166	3, 018, 338
1904	6, 572, 075	1, 942, 248	2, 623, 157	2, 006, 670
1909	5, 476, 270	1, 561, 508	2, 025, 038	1, 889, 724
1914	3, 917, 666	1, 312, 230	1, 391, 001	1, 214, 435
1919	2, 691, 868	699, 639	1, 116, 338	875, 891
1924	2, 446, 917	572, 043	1, 049, 468	825, 406
1929	1, 900, 000	400, 000	880, 000	620, 000
1934	740, 000	140, 000	320, 000	280, 000
1936	1, 110, 000	180, 000	460, 000	470, 000
1937	1, 150, 000	160, 000	470, 000	520, 000
1938	880, 000	120, 000	420, 000	340, 000
1939	953, 960	144, 239	405, 618	404, 103
1940	1, 015, 176	151, 971	436, 117	427, 088
1941	1, 225, 822	198, 196	473, 617	554, 009
1942	1, 246, 765	231, 812	483, 843	531, 110
1943	994, 083	195, 658	391, 466	406, 959
1944	1, 228, 100	242, 100	433, 200	552, 800
1945	923, 052	186, 090	316, 078	420, 884
1946	1, 116, 943	205, 371	391, 853	519, 719
1947	1, 310, 266	244, 363	485, 806	580, 097
1948	1, 295, 000	240, 000	440, 000	615, 000

SOURCE: 1869–1946. U. S. Dept. Agr. Misc. Pub. 669, Lumber Production in the United States, 1799–1946.
1947. Bureau of the Census, U. S. Dept. of Commerce.
1948. Lake States Forest Experiment Station estimates.

TABLE 36.—*Pulpwood consumption in the Lake States region, by States, 1899–1949*[1]

Year	Region total	Minnesota	Wisconsin	Michigan
	Thousand cords	*Thousand cords*	*Thousand cords*	*Thousand cords*
1899			211	34
1904	498	28	388	82
1909	756	47	576	133
1919	1, 265	204	854	207
1924	1, 562	239	1, 071	252
1929	1, 814	266	1, 234	314
1934	1, 305	213	824	268
1936	1, 666	323	1, 035	308
1937	1, 724	335	1, 084	305
1938	1, 496	255	970	271
1939	1, 659	245	1, 106	308
1940	1, 866	349	1, 205	312
1941	2, 189	479	1, 385	325
1942	2, 741	584	1, 810	347
1943	1, 916	426	1, 210	280
1944	2, 585	515	1, 670	400
1945	2, 400	500	1, 550	350
1946	2, 860	600	1, 845	415
1947	2, 583	580	1, 605	398
1948	2, 951	725	1, 741	485
1949 [2]	2, 100	455	1, 325	320

[1] Quantities shown for 1941–46 and 1948–49 are annual receipts rather than consumption. All volumes converted to equivalent of rough wood in cords of 128 cubic feet.

[2] Preliminary.

SOURCE: 1899–1940, 1947. Bureau of the Census, U. S. Dept. of Commerce.
1941–44. Regional totals from the War Production Board; State estimates by Lake States Forest Experiment Station.
1945–46, 1949. Regional totals based on data for the North Central States reported by the Bureau of the Census, U. S. Dept. of Commerce; State estimates by Lake States station.
1948. Lake States station estimates.

TABLE 35.—*Lumber sawed in the Lake States region, by species, 1936–47*

[In millions of board feet]

Species	1936	1937	1938	1939	1940	1941	1942	1943	1944	1945	1946	1947
All species	1, 110	1, 150	880	954	1, 015	1, 226	1, 247	994	1, 228	923	1, 117	1, 310
Softwood:												
Pine [1]	166	160	138	142	150	196	218	194	238	174	188	225
Hemlock	271	296	208	242	247	309	261	203	194	136	190	212
Other	18	18	17	20	29	22	21	13	18	19	25	39
Total	455	474	363	404	426	527	500	410	450	329	403	476
Hardwood:												
Aspen [2]	54	46	44	53	51	73	116	93	131	111	152	200
Basswood	58	51	44	49	50	48	51	42	50	38	43	53
Beech	9	13	10	14	9	18	23	16	26	18	25	25
Birch	140	151	106	86	98	111	110	87	107	73	74	78
Elm	45	38	35	39	48	47	48	37	58	49	63	74
Maple	309	333	223	240	233	309	303	232	283	215	226	254
Oak	31	33	48	58	85	80	81	65	100	76	109	122
Other	9	11	7	11	15	13	15	12	23	14	22	28
Total	655	676	517	550	589	699	747	584	778	594	714	834

[1] Includes white, red, and jack pines.

[2] Includes aspen, cottonwood, and balm-of-Gilead.

SOURCE: 1936–46. Totals from U. S. Dept. Agr. Misc. Pub. 669, Lumber Production in the United States, 1799–1946.
1936–41. Species break-down estimated by Lake States Forest Experiment Station.
1947. Bureau of the Census, U. S. Dept. of Commerce.

☆ U. S. GOVERNMENT PRINTING OFFICE: 1950